PROGRAM OF THE

87TH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF PHYSICAL ANTHROPOLOGISTS

APRIL 11 – 14, 2018

To be held at the

Hyatt Regency Austin
208 Barton Springs • Austin, Texas 78704

JW Marriott Austin
110 E 2nd St. • Austin, TX 78701

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MESSAGE FROM THE VP & PROGRAM CHAIR

It is my great pleasure to welcome you to the 2018 meeting of the American Association of Physical Anthropologists. This year's meeting is our 87th, and will be held in Austin, Texas. The main conference hotel, the Hyatt Regency Austin, is located on the shores of the Colorado River and is in a perfect location just across the bridge from downtown Austin. Our programming officially begins on Wednesday, April 11th, with the **Committee on Diversity Undergraduate Research Symposium** (open to everyone from 6:00-8:00 pm) and the **Opening Reception** (8:00-11:00 pm). This year we will kick off the main scientific program on Wednesday evening with an invited poster symposium (**IDEAS Alumni Symposium: Creating and Supporting Diverse Communities within the AAPA**, organized by Felicia Gomez, Ripan Malhi, Agustín Fuentes, and Susan Antón) and a contributed poster session (**Education in Anthropology**, chaired by Elizabeth Evangelou and Tessa Somogyi), which describes recent research on best practices in classroom and museum teaching. These poster sessions run from 8:00-11:00 pm, just down the hall from the Opening Reception. All Wednesday events take place at our second conference hotel, Downtown Austin's JW Marriott.

This year's program includes over 1200 scientific papers, which will be presented in podium or poster sessions on Wednesday evening or during one of the three full days of the meeting. The 75 scientific sessions include 8 invited podium symposia, 16 invited poster symposia, 22 contributed podium sessions, and 29 contributed poster sessions. In addition, there are 10 workshop sessions that run in parallel to the scientific program. We made the change this year to hold five simultaneous podium sessions, which increases the overall number of podium slots available in the scientific program and helps accommodate the large number of abstract submissions with podium presentation as their preference. We are extremely pleased that our program is again highly international, with scientists from all over the world including Europe, Latin America, Africa, Asia, the Middle East, and Australia!

Due to the size and complexity of our meetings and following similar associations, this year we will require that podium presentations be uploaded onto a central secure server in the Speaker Ready Room no later than a half day before the presentation. This server will then "push" presentations to the appropriate meeting room and will be available for the session. Thank you in advance to all presenters for helping us make this change as painless as possible!

We are pleased to be joined in Austin by the **Paleopathology Association (PPA)**, the **Human Biology Association (HBA)**, the **Paleoanthropology Society (PAS)**, the **American Association for Anthropological Genetics (AAAG)**, and the **Dental Anthropology Association (DAA)**. Due to the size and complexity of our meetings, we will fully use our space allocation at both conference hotels. All PPA, PAS, AAAG, and DAA events will take place in the Hyatt Regency, while HBA events will be in the JW Marriott, which is located just a short walk across the Congress Avenue Bridge from the Hyatt Regency. Speaking of the Congress Avenue Bridge, it is home to the world's largest urban bat colony; at dusk in summer months (including April!), up to 1.5 million migratory Mexican free-tailed bats emerge to feed and this has become a major Austin tourist attraction.

This year's daily session schedule will follow a similar timetable to that started in New Orleans in 2017. This includes morning (8:00 am) and afternoon (2:30 pm) podium sessions, with invited poster symposia starting at the same times. To accommodate the large number of poster presentations, we are hosting two contributed poster sessions per day (each of which includes several of its own sessions). The morning contributed poster session takes place from 7:00 am-1:00 pm (with authors present

from 7:00-8:00 am and noon-1 pm; given the early start we will have breakfast available) followed by a poster switchover from 1:00-1:30 pm. The afternoon session begins at 1:30 pm (with authors present from 1:30-2:30 pm) and an end time of 7:00 pm on Thursday, 6:30 pm on Friday, and 6:00 pm on Saturday in order to accommodate the Auction, Business Meeting, and Closing Reception, respectively (see details below). Poster authors are present for the last hour of the afternoon contributed poster sessions (6:00-7:00 pm on Thursday, 5:30-6:30 pm on Friday, and 5:00-6:00 pm on Saturday). The late start (2:30 pm) of podium presentations and invited poster symposia allows dedicated time for viewing of posters as well as an assortment of lunchtime events and workshops. Given the complexity of our meetings, we are fortunate to again have an **AAPA Meetings App**, developed by Ed Hagen, to help us track times and locations! The app is available for both Android and Apple.

The Wiley Symposium this year is a Thursday morning invited podium session, The **Forgotten Lineage(s): Paleobiology of *Paranthropus***, organized by Paul J. Constantino and Bernard A. Wood. Our joint AAPA-HBA session, which will be held on Friday morning, is the podium session **Health, Disease, and Life History**, chaired by Angela Garcia. The joint AAPA-AAAG session this year will be held on Friday afternoon, and is an invited podium symposium titled **Genomic Diversity in South Asia and Its Implications for the Population History of Modern Humans**. It is organized by Theodore G. Schurr. Finally, the joint AAPA-PPA session, **Going Beyond the "Biocultural Synthesis": Bridging Theory and Practice in Bioarchaeology**, organized by Colleen M. Cheverko, Julia R. Prince-Buitenhuys and Mark Hubbe, will be held on Thursday afternoon.

This year we have planned a number of new activities that occur before and during our annual meeting. Because of space limitations, some of the workshops and events require pre-registration (information is available on our meeting website; pre-registration closes on April 1). These events include three workshops on Wednesday (**3D Morphology with Open-Source Software; Science Communication and Engagement with Religious Publics; and, Social Network Analysis using R**); two events on Thursday (**Professional Ethics in Biological Anthropology: How to Approach an Ethical Dilemma** [sponsored by the AAPA Ethics Committee] and **AAPA Diversity: Reflections on the 2017 Symposium and Future Directions for Biological Anthropology** [co-sponsored by the AAPA Committee on Diversity]). The Friday lineup includes several events (**Teaching in the 21st Century** [sponsored by the AAPA Committee on Diversity AACT]; **Balanced: A Panel on Family Life and Careers in Academia** [sponsored by AAPA Committee on Diversity-WIN]; and, an **open forum on the development of a formal AAPA mentoring program** [sponsored by the AAPA Executive Committee and the AAPA Committee on Diversity]) and a **Wikipedia editing workshop** (sponsored by the AAPA History and Awards Committee). Our final day, Saturday, includes a lunchtime event, **Families and Fieldwork: Navigating Work-Life Balance**.

On Thursday, we are excited to hold our annual **Auction**, which starts with a longer than ever before silent auction (10:00 am-7:00 pm) and ends with the always entertaining live auction (7:00-8:30 pm), which will again be emceed by auctioneer Jon Bethard. Each year, the auction raises thousands of dollars to support Pollitzer Student Travel Awards. Please participate through donations (contact organizers Myra Laird [U Chicago], Valerie Burke DeLeon [U Florida], or Jon Bethard [USF], if interested) and by bidding on our array of enticing auction items. Students, submit your nominations for **Amazing Advisors** and raffle tickets for **Breakfast with Bigwigs** (formerly Lunches with Luminaries) during the auction (you must be present to win!). Our bigwig pairings this year

are: Anne Grauer and Ken Weiss, Lyle Konigsberg and Susan Frankenberg, and Marilyn Norconk and Laura MacLatchy.

This year we are transitioning away from our traditional AAPA Luncheon on Saturday (because of the high cost of the lunch) in favor of returning to holding a Plenary Lecture. This year's **Plenary Lecture** is actually a rescheduling from last year because of the cancellation resulting from the March for Science. It will be given by primatologist and molecular ecologist Anthony Di Fiore and is entitled **In the House of the Piranha: Twenty-Five Years of Field Research in the Ecuadorian Rainforest**; it will be held on Friday from 1:00-2:00 pm in Zilker 4.

Also on Friday—following the conclusion of the scientific sessions—the annual **Business Meeting and Awards Presentation** will run from 6:30-8:30 pm. Student members are encouraged to attend! This meeting will include acknowledgement of this year's IDEAS Scholars, Early Career Grants, and Pollitzer and COD Undergraduate Research travel awards, as well as presentations of the Charles R. Darwin Lifetime Achievement Award and the Gabriel W. Lasker Service Award. Please join us in celebrating this year's winners.

This year's **Presidential Panel (Should the AAPA Change Our Name?)** will be held on Saturday from 12:30-2:15 pm in Zilker 4. It will feature what will almost certainly be a spirited discussion about whether it is time to change the Association's name. Some see it as a way to shake off historical baggage connected to 'Physical Anthropology' and better reflect the modern discipline, while others feel we should retain our name and thus maintain the tradition of the field in much the same way the NAACP has kept its name. Come and debate this issue with senior and junior members of the Association. Our future depends on it! Saturday brings our meetings to a close, with the **Student Awards Ceremony and Closing Reception** from 6:00-9:00 pm. Please join us to learn who won the 2018 Student Presentation Awards!

I am grateful to all those who have helped assemble the 2018 program. Thanks are due to our meetings guru, Lori Strong (from Burk & Associates), as well as Ed Hagen (our webmaster, app developer, and member of the Austin Advance Team). A huge thank you goes to the 39 members of the Program Committee and to the Austin Advance Team. The Advance Team consists of Officers and representatives from Burk, as well as several members of the Program Committee; this group visited Austin in January to arrange the scientific program and to finalize hotel details. The program assistant, Christabelle Dragoo, has been a tremendous help, as have the Officers and other members of the Executive Committee. Special thanks to Leslie Aiello for stepping in on numerous occasions to help with details. Finally, thanks to the Local Arrangements Committee—the dynamic duo of Anthony Di Fiore and Liza Shapiro. These meetings would not have been possible without all these exemplary individuals, so please join me in thanking them when you see them in Austin!

This year is the first year that the conference program will not be published in the meeting supplement—there are just too many changes to the program once the supplement goes to press. Instead, the meeting program is available in printed form at the meetings, online on the meeting website (www.physanth.org/annual-meetings/annual-meeting-2018), and in the meetings app.

See you in Austin!

J. Josh Snodgrass
AAPA Vice President and Program Chair

ABSTRACTS

Chimpanzees are fatter than you think: Differences in regional body fat deposition between hunter-gatherers and captive chimpanzees

ALAN ACHENBACH[1], YUZURU HAMADA[2], RUSSELL D. GREAVES[3] and KAREN L. KRAMER[4]

[1]Biological Anthropology, University of Utah, [2]Primate Research Institute, Kyoto University, [3]Ethnoarchaeology, University of Utah, [4]Biological Anthropology, University of Utah

It has been widely suggested that humans and chimpanzees differ in their pattern of regional body fat distribution. Based on qualitative observations, chimpanzees (both wild and captive) have been characterized as preferentially depositing fat centrally. However, no known quantitative test has been conducted comparing within sex differences between humans and chimpanzees in peripheral and central body fat deposition. To assess differences in regional deposition, this study utilizes suprailliac (central) and triceps (peripheral) skinfold data from a group of captive chimpanzees (Hamada et al., 1996; male, n=40; females, n=45). We compare the chimpanzee data to the Savanna Pumé, a group of South American hunter-gatherers (males, n=39; females, n=34). Mann-Whitney U tests are used to evaluate within sex differences in regional body fat between species. Results show that triceps skinfolds do not differ between human and chimpanzee males (U=1456, Z=0.692, p=0.49). However, supraiiliac skinfolds do differ (U=849, Z=3.88, p<0.0001), e.g. male captive chimpanzees are fatter centrally than Pumé males. Human females have significantly greater triceps skinfolds (U=833, Z=4.88, p<0.0001), but reduced supraiiliac skinfolds (U=1044, Z=3.52, p=0.0004) compared to female chimpanzees. The results suggest that 1) well-fed captive chimpanzees of both sexes are fatter centrally than our population of hunter-gatherers, 2) human and chimpanzee males do not differ peripherally, however 3) human females have a significantly greater capacity to deposit peripheral body fat. These results are consistent with hypotheses that human females have adapted regional body fat storage to facilitate increased reproductive demands.

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Endemic warfare and scurvy in Historic period Croatia

ANITA ADAMIC, ZELJKA BEDIC, VLASTA VYROUBAL and MARIO SLAUS

Anthropological Center, Croatian Academy of Sciences and Arts

From the 15th to 18th century AD the past inhabitants of Croatia were embroiled in continuous, low-intensity warfare with the Ottoman Empire making Croatian archaeological series from this period a unique resource for studying the effects that endemic warfare has on health. Here we analyze and compare the frequency and distribution of scurvy in three composite skeletal series: a pre-endemic warfare series dated from the 10th to 14th Century, an endemic warfare series from the 14th to 16th Century, and an additional Vlach series dated from the 16th to 18th Century consisting of migrant people originating from the Balkan region that were settled in Croatia by the Ottomans in return for military service. We hypothesize that by causing massive emigration, reduced mobility, closing of markets, and loss of effective labor and resource utilization, long-term endemic warfare increases metabolic stress. Scurvy was assessed separately in subadults and adults and diagnosed into three categories as: definite, probable, or possible with the aid of statistical correlation analyses according to criteria described by Geber and Murphy (2012). The resulting data support the proposed hypothesis by showing a significant increase in total scurvy frequencies (12.8% to 30.1%, P=0.00002) during the endemic warfare period with subadults being more affected than adults. The Vlach series exhibits intermediate values, significantly higher than the pre-endemic warfare series (P=0.016), but lower than the endemic series. Additionally, at the level of the complete adult sample, males were significantly more susceptible to scurvy than females (24.2% compared to 6.8%, P=0.0006).

This research was funded by Croatian Science Foundation Project number 8100.

Interspecific mobbing and cooperation between Rylands' bald-faced saki monkeys (*Pithecia rylandsi*) and sympatric primate species in Peru

DARA B. ADAMS and DAWN M. KITCHEN

Anthropology, The Ohio State University

While some primate species respond to threats by fleeing or hiding, others approach, harass, and occasionally attack predators. This 'mobbing' behavior has been reported in various primates but is notable among Neotropical species. We report on interspecific mobbing by our focal species, saki monkeys (*Pithecia rylandsi*), and sympatric species at Los Amigos Biological Station, Peru. To elicit anti-predator behaviors, we conducted experiments (n = 36) on sakis using ocelot, boa, and harpy eagle models. We documented saki behavior and noted presence and response of nearby primate groups during experiments. In response to eagle and boa models, sakis emitted infrequent, quiet alarm calls and rarely exhibited mobbing behaviors. In contrast, sakis actively mobbed ocelot decoys while emitting prolonged, noisy alarm calls. Heterospecific species responded in only 8% of eagle and 8% of boa experiments by approaching from nearby to briefly inspect decoys. Interestingly, heterospecifics responded in 33% of ocelot experiments by approaching from a distance and mobbing the decoy (avg. 13 mins). Each mobbing event involved up to 40 individuals including two or three heterospecific species: squirrel monkeys (*Saimiri boliviensis)*, capuchins (*Cebus apella)*, or tamarins (*Saguinus fuscicollis*, *S. imperator)*. Interspecific mobbing included vocalizing, surrounding, lunging, and throwing branches at decoys, with heterospecific participants maintaining close proximity to one another. These observations are compelling given that sakis otherwise rarely associate with other primate species and are often displaced by capuchins at feeding sites. Our data suggest mobbing calls may have a greater influence on formation of multi-species mobbing events than previously recognized.

This research was supported by National Science Foundation (BCS-1341174), Animal Behavior Society, Society of Integrative and Comparative Biology, and The Ohio State University (Columbus and Mansfield).

Fuzzy logic as an approach for assessing population relatedness and phenotypic variation

DONOVAN M. ADAMS, REBECCA L. GEORGE and MARIN A. PILLOUD

Department of Anthropology, University of Nevada, Reno

Human variation undeniably occurs along clinal gradations, with frequencies of traits and variations in size along a continuous spectrum in the human species. As such, bioarchaeological studies of biological distance have received critiques in the literature of being "typological," while others have argued that the analysis of variation and patterns assists in understanding human relationships. To address these issues, the present research uses a novel statistical approach for biodistance analyses: fuzzy logic.

To assess the efficacy of fuzzy logic on closely related populations, the present analysis employs odontometric and dental morphological data (n=6038) collected by Tsunehiko Hanihara from fifteen populations across the globe. These data were separated by sex as preliminary analyses showed poor performance with z-scores. Raw data and principal component variables were compared and modeled in an Adaptive Neuro-Fuzzy Inference System (ANFIS) to evaluate group membership. This approach utilizes an artificial neural network to construct a system of IF-THEN rules to produce a crisp output. Fuzzy c-means analyses were also conducted to evaluate similarities between individuals and populations. Each individual is given a fuzzy output membership for each cluster, which assesses the similarity of the individual to each available cluster. ANFIS models performed poorly, with greater success at group allocation for males. C-means analyses found moderate success in identifying known

population relationships and histories, particularly with females. Currently, the potential of fuzzy logic is promising; however, the method is inadequate for use on dental morphology due to issues with missing data.

Virtual reconstruction of the kebara 2 neanderthal pelvis

MAYOWA T. ADEGBOYEGA[1], JEAN-JACQUES HUBLIN[2] and TIMOTHY D. WEAVER[1,2]

[1]Department of Anthropology, University of California, Davis, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology

The paucity of well-preserved hominin pelvises in the fossil record has hindered robust analyses of the evolutionary mechanisms behind critical biological processes including locomotion, thermoregulation, and childbirth. Here, we present a virtual reconstruction of the Kebara 2 Neandertal pelvis from Mount Carmel, Israel, and reexamine current assumptions about Neandertal pelvic morphology.

Three-dimensional models of the fragments of the right innominate and sacrum were created from CT scans, and then individually manipulated into proper anatomical position. The objective of this study was to correct a previously identified misalignment of the ischiopubic ramus, and to realign the sacral vertebrae. Virtual reconstruction techniques also allowed us to recreate the damaged left half of the sacrum and the left innominate through mirroring to produce a more complete representation of the Kebara 2 pelvis in particular, and of Neanderthal pelvic anatomy in general.

Analyses of the reconstruction revealed a rounder pelvic inlet and outlet than was previously established by Rak (1991, Paris: CNRS 2, 147-156) and Tague (1992, AJPA). We also observed a slightly more anteriorly positioned sacral promontory and pubic symphysis within the pelvis, as well as a higher ratio of the anteroposterior length of the inlet behind the anterior margins of the acetabula than was described by Rak & Arensburg (1987, AJPA). We will discuss these results, as well as their implications for understanding Neandertal pelvic morphology and the evolution of the hominin pelvis.

Workload intensity and health during Portugal's corporatist Estado Novo as reflected by the skeleton

GINA M. AGOSTINI

Obesity Solutions, Mayo Clinic - Arizona State University

The skeleton dynamically responds to stresses experienced by an individual. This makes bone an important source to investigate the impact of sociopolitical change on working class life in more candid fashion than might be revealed through historical documents alone. This project investigated how the procorporate culture of Portugal's Estado Novo (1928 - 1974) affected working class health and workload.

Sample-wide demographic information was coupled with targeted skeletal assessments of health (e.g., infection, malnutrition) and physical activity/workload (osteoarthritis severity and limb bone robusticity) for 97 adults from early-to-mid 20th century Lisbon. Results confirm that overall health and life expectancy significantly declined over time while workload intensified, with individuals who died in the 1930s and 1940s (the Estado Novo) being most strongly affected. Furthermore, a separate comparative study showed limb bone robusticity for Estado Novo individuals was significantly higher than that of individuals from contemporaneous Bologna for all six bones evaluated (both humeri and radii, right femur and tibia), indicating a higher work burden in Lisbon relative to another urban, industrializing sample from South Europe.

The declines to quality of life in the Estado Novo working class seem at conflict with historical reports confirming the new regime produced strong economic growth. Similar trends have been reported for other populations, particularly those with marked stratification where financial gains and other benefits flow disproportionately to upper classes. These results confirm the importance of supplementing archival data with skeletal assessments to understand the full impact of sociopolitical change on working class life.

This project was supported by the "Culture and Heritage in European Societies and Spaces" program and the University of Massachusetts Amherst

Constraint, Integration, and Evolvability of the Primate Shoulder Functional Trait Complex

ELIZABETH R. AGOSTO and BENJAMIN M. AUERBACH

Anthropology, The University of Tennessee

Scapular morphology is closely associated with locomotor behavior in vertebrates, especially primates. Interspecific differences are posited to be the result of morphological responses to directional selection arising from specific behaviors. However, functionally important traits can evolve through correlated responses to selection in covarying traits. The scapula is part of a complex of functionally related traits, linked developmentally and mechanically, including the clavicle, humerus, and basicranium. This study assesses whether the functional relationships among these skeletal regions have evolutionary consequences by comparing patterns of integration and evolvability among homologous traits in humans and tamarins.

The strength of integration is quantified using the analysis of eigenvalues and a measure of trait autonomy. Evolvability is estimated by applying simulated random selection gradients to the phenotypic variance/covariance matrices and comparing evolutionary responses among taxa. These analyses are applied to a complex of traits relating to mechanical function from both the basicranium and shoulder girdle, analyzing them together and separately. When traits from the basicranium and shoulder girdle are evaluated as a complex, results indicate the ability of these regions to respond to selection is decreased compared to their responses were they independent. This is indicative of evolutionary constraint among these regions. Therefore, their independent evolution is not supported. While this pattern is evident for both species, humans present more integration and lower evolvability. Morphological differences in the nuchal region and shoulder complex between these species reflect differences in the ability to respond to selection, which may have had functional consequences among apes and monkeys.

A novel approach to understanding food electivity in Bornean orangutans (*Pongo pygmaeus wurmbii*)

SHAUHIN E. ALAVI[1,2], SRI SUCI UTAMI ATMOKO[3] and ERIN R. VOGEL[1,2]

[1]Department of Anthropology, Rutgers, the state university of New Jersey, [2]The Center for Human Evolutionary Studies, Rutgers, the state university of New Jersey, [3]Fakultas Biologi, Universitas Nasional, Jakarta

Much effort has gone into exploring ways to understand food preference in primates. Recently, there has been increased interest in understanding the role of nutrition in shaping foraging behavior and food preference. Traditionally, food electivity indices were calculated to rank the relative importance of food items in the diet. Here, we explore the relationships between macronutrient profiles of food items and Vanderploeg and Scavia's relativized electivity index (E*) using diets from wild Bornean orangutans *(Pongo pygmaeus wurmbii*). We also present a novel use of isoclines for evaluating the nutritional value of food items. Data were collected at the Tuanan Research Station in Central Kalimantan, Indonesia. Using generalized additive models (GAM), we show that macronutrient content has a significant, nonlinear positive effect on E* (GAM, $p < 0.001$). We also show that although food items differ in absolute amounts of nutrients, they often fall on the same intake isocline, indicating equivalent rates of nutritional return between such items. We find that accounting for the rate of nutritional intake per food items represented by the isoclines improves the deviance explained in E (GAM, $p < 0.001$). We suggest the use of isoclines as an

effective visual method for evaluating the relative quality and preference of food items.

Funding citation: United States Agency for International Development; The Center for Human Evolutionary Studies; International Primatological Society, National Science Foundation, Rutgers Department of Anthropology

Ape quest in the Vallès-Penedès Basin (2014–2017): Fieldwork results and prospects for the future

DAVID M. ALBA[1], SALVADOR MOYÀ-SOLÀ[1,2,3], DANIEL DEMIGUEL[1], ISAAC CASANOVAS-VILAR[1], MIGUEL GARCÉS[4,5], JOSEP M. ROBLES[1], JOAN MADURELL-MALAPEIRA[1] and SERGIO ALMÉCIJA[1,6]

[1]Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, [2]ICREA, Institució Catalana de Recerca i Estudis Avançats, [3]Unitat d'Antropologia (Departament de Biologia Animal, Biologia Vegetal i Ecologia), Universitat Autònoma de Barcelona, [4]Departament de Dinàmica de la Terra i de l'Oceà, Facultat de Ciències de La Terra, Universitat de Barcelona, [5]Institut Geomodels, Grup de Recerca Consolidat de Geodinàmica i Anàlisi de Conques, Universitat de Barcelona, [6]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University

We report preliminary results of paleontological fieldwork (surveys, samplings and excavations) performed in 2014–2017 at several Miocene successions of the Vallès-Penedès Basin (Vallès sector), with the aim to recover new hominoid remains and contextualize previous findings. The areas of Can Poncic (CP) and Can Pallars i Llobateres (CPL) were prospected (2017), whereas excavations continued at Can Llobateres (CLL, 2014–2015) and were resumed, after decades of inactivity, at Castell de Barberà (CB, 2014–2015) and Creu de Conill (CCN, 2016–2017). No further *Hispanopithecus* remains were found at CLL1 (9.8 Ma), whose low fossiliferous richness recommends to redirect future fieldwork efforts on other areas: CCN, where abundant fossils (but no primates) were recovered from an earliest Vallesian layer (11.2 Ma); and CPL, where a maxillary fragment of *Hispanopithecus* cf. *laietanus* was surface-collected close to the classical outcrops (10.0–9.7 Ma). In turn, prospections/excavations at CB enabled to locate the main fossiliferous horizon. Although it is mostly exhausted, the find of *Hippotherium* remains and magnetostratigraphic analyses unambiguously confirm the formerly-contentious earliest Vallesian age (11.2 Ma) of this site. In contrast, the type locality of *Hispanopithecus crusafonti* (CP1) could not be determined, due to extensive vegetation cover. Nevertheless, we were able to approximately locate the classical CP outcrops (10.3–10.0 Ma). In years to come, magnetostratigraphic sampling of CPL and CP could enable a more accurate dating of previous hominoid finds from these areas, while further excavations at CCN are the most promising for finding additional hominoid remains in this basin.

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Assessing age at puberty using skeletal markers in a medieval population from Sudanese Nubia

GRACE N. ALBERS and DAWN MULHERN

Anthropology, Fort Lewis College

Puberty marks a biological transition between childhood and adulthood, but has social significance through increased participation and responsibility within families, communities, and cultures. In addition to demonstrating the trajectory of biological development, examining puberty markers in archaeological populations may provide an estimate of when the social threshold of adulthood was crossed, and to what extent it varies within or across populations. A recently developed method for assessing age at puberty for an archaeological sample (Shapland and Lewis 2013) was used in the current study. Puberty markers including hamate hook development, anterior curvature of cervical vertebral bodies, and radial and iliac crest fusion were assessed for 51 individuals aged 10 to 18 from two medieval cemeteries at Kulubnarti in Sudanese, Nubia. Previous studies indicate that individuals in the S cemetery at Kulubnarti showed poorer health compared to the R cemetery, potentially resulting in differential growth during adolescence. Results demonstrated that the S cemetery had an earlier average age for each stage of puberty, up until peak height velocity during which the average age for the S cemetery was 16, 14.6 for the R cemetery. Also only the R cemetery had individuals in the deceleration phase of puberty within the observed age range. Although Mann Whitney-U tests comparing ages at different stages of puberty between the two cemeteries did not show any statistically significant differences, the overall pattern suggest that there may be some lagging of later pubertal timing in the S cemetery compared to the R cemetery.

Elucidating ancestry variation in the Philippines via mixture analysis

BRIDGET FB. ALGEE-HEWITT[1], MATTHEW C. GO[2], BEATRIX DUDZIK[3] and CRIS E. HUGHES[2]

[1]Biology, Stanford University, [2]Anthropology, University of Illinois Urbana-Champaign, [3]DeBusk College of Osteopathic Medicine, Lincoln Memorial University

This project applied unsupervised model-based clustering to infer proportions of continental – Asian, African and European – ancestry from cranial shape data for 330 individuals from the Philippines. We studied four different samples: a contemporary collection of forensic relevance from Manila, the Howells and Hanihara Philippines series, and the Hanihara Philippines-Negrito series. We also included craniometrics for parental reference samples (n=977) to capture the variation for the most likely sources of continental ancestry. Using the optimal, three-cluster, solution, which corresponds to a trihybrid-ancestry model, we calculated proportions of Asian, African and European ancestry for each individual and mean percent values for each population. Population of origin explains ≈60% of the variation in each ancestry component. Significant differences exist among the geographic populations and some of the Philippines samples. Filipinos appear considerably admixed, relative to the other Asian populations, carrying, on average, less Asian ancestry (70%) than our Korean (99%), Japanese (96%), Thai (93%), and Vietnamese (84%) reference samples. Asian ancestry is greatest (76%) for the Manila sample; the Negrito sample has equal Asian and African (47%) ancestry. Using models with more clusters, we identified patterns of relationships between, and evidence of substructure within, the parental reference samples and Philippines populations. The Manila sample often aligns with low-admixture Asian groups, while the Howells and Hanihara series show greater affinity with the European and African groups. We repeated our analyses including Australo-Melanesian data. The trends discovered for the Southeast Asian samples agree with genetic admixture studies and population interactions in this region.

Computing Ancestry and Race: narrative and semantic patterns in the forensic language of identity

MARK A. ALGEE-HEWITT[1] and BRIDGET FB. ALGEE-HEWITT[2]

[1]English, Stanford University, [2]Biology, Stanford University

While the assessments of identity by Biological researchers and Forensic practitioners in Anthropology strive for scientific objectivity, these results must be communicated in writing, whether among members of the scientific community, to law enforcement, or even to members of the wider public. Yet, the language chosen by members of the field not only greatly influences the way that that their work is understood by these three groups, it also reflects the implicit assumptions about group membership that are internalized by the researcher and reflected in his or her work. In this project, we combine the methodologies of stylometry and computational linguistics to assess how identity is communicated by the field. To identify and study the discourse of identity that is internal to biological and forensic anthropology, we use Natural Language Processing and stylometric

methods to analyze a corpus of professional articles, identifying the specific language patterns that adhere to both particular group identities (e.g. African American, Asian, Hispanic), as well as to types of identities (race, ethnicity, ancestry). We complement this work by performing the same analysis on a corpus of newspaper articles, as well as on a control corpus of literature. Our results show how a different discourse attaches to different groups in anthropology articles, which mirrors the discourse of identity in both the newspaper and literature corpus. We also show how the movement between 'race' to 'ethnicity' and 'ancestry' in anthropological literature marks a primarily linguistic shift that echoes larger social changes in our understanding of identity.

Entheseal stress patterns as a form of structural violence: Evidence from the hamann-todd osteological collection (1913-1935)

ANNA P. ALIOTO

Anthropology, Western Michigan University

Recent studies in biological anthropology have aimed to understand how structural violence can be observed among different populations and interpreted using skeletal remains. Despite this, there has been limited research conducted on how entheseal stress patterns can be interpreted to suggest evidence of structural violence. The objective was to demonstrate that entheses can be used to understand structural violence by examining the amount of wear and patterning at each enthesis site in conjunction with other indicators such as pathology. This would indicate the amount and type of physical labor individuals were subjected to throughout their lives. The objective was then tested using two different sub-population studies from the Hamann-Todd Osteological Collection which consists of individuals who lived in Cleveland, Ohio. The first sub-population study examined possible structural violence among biological affinity ("race") by examining entheses among African (n=45) and Caucasian Americans (n=45). The second group examined place of origin in which American-born Caucasians (n=20) were compared to European-born Caucasians (n=25) to test for possible disparities. Results indicate that the majority, about eighty percent, of enthesis sites were similar between African and Caucasian Americans and about ninety percent of sites were similar between American-born and European-born Caucasians. Despite this, there are subtle instances of site locations which demonstrate statistically significant differences and may be indicative of different occupations or labor stresses. This research demonstrates that physical stress and labor, once viewed within a structural violence framework, is a significant factor when examining the lived experiences of population sub-groups.

Does endocast shape co-vary with diet across primates?

KARI L. ALLEN

Neuroscience, Washington University School of Medicine in St. Louis

Several studies have posited that variation in cognitive demands associated with acquiring dietary resources may explain adult interspecific variation in brain size and/or mosaic evolution of brain proportions in primates. Some further suggest that this relationship is illustrated by covariation between endocranial shape and diet within some clades; however, both endocranial shape and diet carry considerable allometric and phylogenetic signal. This study re-examines the proposed relationship between diet and endocranial shape with consideration of these confounding variables.

Virtual endocast were extracted from microCTs of extant Haplorhine (n=39) and Strepsirrhine (n=17) species. Forty-two 3D landmarks were used to capture overall surface shape. Species were categorized based on dietary information available in the literature. Results of Procrustes ANOVA indicate significant differences between extant haplorhines and strepsirrhines in landmark configuration ($p<0.0001$) and centroid size ($p=0.028$). Endocast shape co-varies with residual endocranial volume ($p<0.0001$, $r2=0.24$) and is weakly correlated with centroid size ($p=0.001$, $r2=0.09$). Haplorhines and strepsirrhines exhibit parallel vectors of shape variation explained by encephalization. When species are pooled, a significant difference in shape occurs among diet categories ($p=0.03$); however, when encephalization and phylogeny are included as covariates, diet category fails to account for a significant amount of variation in endocast shape.

Results indicate that global endocast shape is better explained by phylogenetic and allometric factors than by diet, per se. Nevertheless, the possibility is explored that localized expansion of the neocortical (i.e. prefrontal cortex) and subcortical (i.e. hippocampus) regions associated with mental mapping may be reflected in minute changes in surface shape.

An Analysis of Biological Diversity and Admixture in Ottoman Romania Utilizing Strontium Isotope and Craniometric Affinity Patterns

KATHRYN GROW ALLEN[1], RYAN MILLS[2], KELLY J. KNUDSON[3] and NOREEN VON CRAMON-TAUBADEL[1]

[1]Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo, [2]Department of Geological Sciences, University of North Carolina at Chapel Hill, [3]Center for Bioarchaeological Research, School of Human Evolution and Social Change, Arizona State University

The Ottoman Empire, one of history's most influential Islamic states, expanded into Southeast Europe during the Early Modern period. There is evidence indicating that the migration of non-European Muslims and the conversion of Europeans to Islam both contributed to the biological makeup of these communities. We present here a craniometric and strontium isotope analysis assessing biological diversity in an Ottoman cemetery excavated in Timişoara, Romania.

Discriminant function analysis was employed to classify Romanian Ottoman crania as either European or Anatolian, categories defined by comparative collections from these regions. The results classified 20 of 26 people with a high typicality probability ($p > 0.05$). Thereafter, a strontium isotope analysis was conducted on enamel samples from 21 Ottoman specimens and compared to values from contemporaneous archaeological fauna. These results placed eight of 21 Ottomans outside of the local baseline range ('non-locals'), the remaining 13 displaying values congruent with local food and water sources ('locals').

A synthesis of the craniometric and isotopic results was possible for 16 individuals, tested in both analyses. Among these, a higher percentage of locals classified as Anatolian, while more non-locals aligned with Europeans craniometrically. While it is unsurprising that non-locals aligned closely with a European comparative population, it was unexpected that locals did not show evidence of admixture. Presumably second (or subsequent) generation Ottomans, the locals appear to have retained intracommunity biological divisions. Hence, despite a shared political and religious identity, the Ottomans in Timişoara may have retained internal diversity by choosing mates alike in ancestral heritage.

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Early Pleistocene ecosystem evolution and heterogeneity at East Turkana, northern Kenya as indicated by stable carbon and oxygen isotope data from mammalian enamel

KAYLA B. ALLEN[1,7], LAUREN ANDERSON[2,7], MARYSE BIERNAT[3,7], AMANDA GUERRERO[4,7], AMANDA MCGROSKY[3,7], KAEDAN O'BRIEN[5,7], JEFFREY SEKINGER[7], BRENDEN ZELLER[1,7], DEGSEW ZERIHUN[7], DAVID R. BRAUN[6,7] and DAVID B. PATTERSON[1,7]

[1]Biology, University of North Georgia-Dahlonega, [2]Anthropology, George Washington University, [3]Human Evolution and Social Change, Arizona State University, [4]Anthropology, University of La Verne, [5]Anthropology, University of Wisconsin-Madison, [6]Human Paleobiology, George Washington University, [7]Koobi Fora Field School, George Washington University

During the Early Pleistocene of eastern Africa, paleoenvironmental data suggest a shift from wooded-brushland environments to more open, grassland-dominated landscapes. Much of the expansion of C4 grasslands in eastern Africa has been substantially assisted by the Turkana Basin record. Although we know that hominins inhabited these dynamic environments, more highly resolved paleoenvironmental analyses are required to understand how these shifts in environments may have affected hominin paleobiology. In this study, we use a large compilation of new and existing fossil enamel carbon and oxygen isotope values (n = 706) dating to this period at East Turkana to investigate dietary evolution and spatial variability in Early Pleistocene ecosystems of this area. We find that although most taxa remain isotopically static (e.g., Reduncini, *Hippopotamus*), some taxa (e.g., *Equus*, Alcelaphini) become depleted in their carbon isotopic signature, which indicates an increased prevalence of C3 vegetation in the diet. Additionally, we find significant heterogeneity in the East Turkana vegetation community throughout this period. Specifically, the Karari Ridge, a sub-region with abundant archaeological localities, had an increased prevalence of C3 vegetation relative to the Ileret and Koobi Fora sub-regions, areas typically associated with abundant hominin remains. These findings may indicate that hominin behavior at East Turkana was structured by an assortment of ecological variables including the distribution of vegetation, sources of water, and stone to make tools.

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A cross-cultural and lifespan-based analysis of the Androgen Hypothesis of Prostate Cancer

LOUIS C. ALVARADO

Anthropology, University at Albany–SUNY

Regarded as a "disease of civilization", prostate cancer is concentrated among industrialized populations and becoming a rising global concern. A relative consensus from animal research, clinical trials, and *in vitro* studies implicates androgen exposure in prostate carcinogenesis. In contrast, epidemiological investigations generally report an equivocal relationship between circulating androgens and prostate cancer risk. Because prostate cancer is primarily a disease of old age, and because population variation in men's testosterone profiles is maximally attenuated during later life, sampling testosterone levels at the ages typical of cancer diagnosis produces limited information for assessing cumulative hormone exposure. Here, I extend previous cross-cultural investigations by integrating a life-course perspective to examine population differences in men's testosterone levels and prostate cancer disparities. A literature search was conducted for studies reporting testosterone levels for younger (<40 years) and older men (≥40 years), along with age-adjusted rates of prostate cancer incidence for the larger sampled populations. In the literature, population samples were generally divided by region and ethnicity: American men of African, Asian, Caucasian, Hispanic, and Pacific Islander descent from several geographic residences, and men from China, Germany, Hong Kong, Japan, Kuwait, New Zealand, Singapore, South Korea, and Sweden. Testosterone values reported for 50 population samples from seventeen studies were standardized in relation to prostate cancer incidence. Population variation in young men's testosterone levels was positively associated with prostate cancer disparities (rs=0.69, P<0.001) whereas no association was found among older men (rs=-0.19, P=0.391), providing cross-cultural and age-specific evidence for the Androgen Hypothesis of Prostate Cancer.

Interactions between bacteria and parasites in the gastrointestinal tract of wild black howler monkeys (*Alouatta pigra*)

KATHERINE R. AMATO[1], NICOLETTA RIGHINI[2], ELIZABETH MALLOTT[1] and RODOLFO MARTINEZ-MOTA[3]

[1]Anthropology, Northwestern University, [2]Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Universidad Nacional Autonoma de Mexico, [3]Biology, University of Utah

The gastrointestinal (GI) tract of non-human primates is inhabited by a range of microorganisms, including bacteria, archaea, microbial eukaryotes, and viruses. While these organisms undoubtedly interact with each other, most studies to date describe relationships between hosts and single groups of GI microorganisms. However, understanding the associations between groups of microbes is likely to provide improved insight into patterns of host health and disease. To this end, we explored the relationship between GI parasites and bacteria in wild black howler monkeys (*Alouatta pigra*) in Campeche, Mexico. Because high GI bacterial diversity is believed to confer host resistance to invasion by GI pathogens, we hypothesized that individuals in which GI parasites could not be detected would have higher GI bacterial diversity. We used fecal samples (N=77) from 26 individually-recognizable howler monkeys to describe parasite prevalence and abundance using flotation and sedimentation techniques and to characterize the GI bacterial community by sequencing the V4 region of the 16S rRNA gene. We detected four parasite taxa, one of which-- *Trypanoxyuris minutus*--is known to inhabit the large intestine. As predicted, *T. minus* infection was associated with altered GI bacterial community composition ($F_{1,77}$ = 1.23, p = 0.02) and reduced GI bacterial diversity (Mann-Whitney U = 252, z = -2.27, p = 0.02). These results demonstrate clear interactions between co-located parasites and bacteria in the GI tract. They also suggest that some GI bacterial communities can reduce host colonization by endoparasites. More detailed examinations of mechanisms and implications for host health should follow.

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Migration and social organization in medieval Europe: A paleogenomics approach

CARLOS EDUARDO G. AMORIM[1], STEFANIA VAI[2], COSIMO POSTH[3], ISTVAN KONCZ[4], DEAN BOBO[1], SUSANNE HAKENBECK[5], MARIA CHRISTINA LAROCCA[6], BALAZS MENDE[7], WALTER POHL[8], CATERINA GIOSTRA[9], TIVADAR VIDA[4], DANIEL WINGER[10], JOHANNES KRAUSE[3], DAVID CARAMELLI[11], PATRICK J. GEARY[12] and KRISHNA R. VEERAMAH[1]

[1]Department of Ecology and Evolution, Stony Brook University, [2]Department of Biology, Università degli studi di Firenze, [3]Archeogenetics, Max Planck Institute for the Science of Human History, [4]Institute of Archeological Sciences, Eötvös Loránd Tudományegyetem, [5]Department of Archeology, Cambridge University, [6]Department of Historical and Geographic Sciences and the Ancient World, Università degli studi di Padova, [7]Institute of Archeology, Hungarian Academy of Sciences, [8]Division of Humanities and the Social Sciences, Austrian Academy of Sciences, [9]Dipartimento di Storia, archeologia e storia dell'arte, Università cattolica del Sacro Cuore, [10]Heinrich Schliemann-Institute of Ancient Studies, Universität Rostock, [11]Dipartimento di Biologia, Università degli studi di Firenze, [12]School of Historical Studies, Institute for Advanced Study

In spite of centuries of research, much about the Germanic migrations that took place between the fourth and sixth centuries in Europe remains hotly disputed. The extent to which this period involved mass invasions and how different populations interacted are topics of vigorous historical and archaeological debates. To better understand this key era that marks the dawn of modern European societies, we obtained ancient genomic data from a large number of samples (N = 63) from two key cemeteries (from Hungary and Northern Italy) that have been previously associated with a Germanic barbarian tribe called the "Lombards", who ruled Italy for almost 200 years after migrating from the historical Roman province of Pannonia. Our dense cemetery-based sampling offered novel insights into the social organization of early Medieval Europeans. For instance, individuals were buried next to their biological kin, suggesting a society organized around biological relationships. In one cemetery, graves were organized around a particularly large, higher status family that is highly militarized and may be analogous to what the written sources term

"fara", the meaning of which has been debated amongst historians. Moreover, we identified a clear pattern of population structure in each of these cemeteries involving at least two ancestry groups that were very distinct in terms of their material culture, suggesting that, although they coexisted, they (at most) only rarely admixed and had different social statuses and roles. Finally, our data are consistent with the long-distance Lombard migration from Pannonia to Northern Italy described in historical texts.

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Beggars *can* be choosers: Water-limited wild red-fronted lemurs (*Eulemur rufifrons*) prefer clean water

CAROLINE R. AMOROSO[1], PETER M. KAPPELER[2,3] and CHARLES L. NUNN[1,4]

[1]Evolutionary Anthropology, Duke University, [2]Behavioral Ecology & Sociobiology, German Primate Center, [3]Sociobiology/Anthropology, University of Göttingen, [4]Global Health Institute, Duke University

Infectious stages of parasites and pathogens are often transmitted via incidental ingestion of food and water. As a result, primate behaviors involving water acquisition are likely shaped by tradeoffs between physiological requirements and infection risk. In previous experiments exploring these tradeoffs, captive lemurs demonstrated a strong preference for clean water when the alternative was contaminated with feces. The present study investigates this preference in a wild population of red-fronted lemurs (*Eulemur rufifrons*) living in the dry, deciduous Kirindy Forest of western Madagascar. Because water is extremely limited in the dry season, individuals that have a strong preference for clean water may risk dehydration. Thus, we expected wild lemurs in this population to show weaker preferences for clean water than captive lemurs, which also may learn to prefer clean water. We introduced two 10-liter buckets of water into the home ranges of three habituated lemur groups, one filled with filtered water suitable for human drinking, and the other filled with water contaminated with lemur feces, disinfected by boiling. Despite water limitations of the habitat, the lemurs strongly preferred the clean water (35 drinking events) to feces-contaminated water (5 drinking events) (p<0.0001, binomial test), consistent with the observed pattern and effect size in captivity. These results suggest that avoidance of feces has been selected in lemurs as a counterstrategy to infectious disease exposure, rather than learned in captivity. We consider the distribution and quality of water available in the habitat and the implications of our findings for parasite transmission in this ecosystem.

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A dental assessment of biological affinity among Celts, Etruscans and Picenis

MALLORY J. ANCTIL[1], JOEL D. IRISH[2] and ISABELLE DE GROOTE[3]

[1]Research Centre in Evolutionary Anthropology and Palaeoecology, Liverpool John Moores University, [2]Research Centre in Evolutionary Anthropology and Palaeoecology, [3]Research Centre in Evolutionary Anthropology and Palaeoecology

Data obtained during an ongoing dental investigation of Celtic and Iron Age (650-240BC) samples of populations possessing Celtic material culture addresses three long-standing, questions. First, was there genetic continuity between Celtic, Etruscan, and Picenic populations possessing Celtic material culture? Second, were north Italian Picenic and Continental Celts variants of the same population? Third, were Celtic migrations during the 4th century BC into Piceni and Etruscan territory accompanied by a concomitant biological change, and the loss of their cultural autonomy? To address these questions dental nonmetric traits from proto-Celtic, Celtic, Etruscan and Picenic populations were analyzed, to help establish local and regional affinities. The Arizona State University Dental Anthropological System was used to record 36 crown, root, and intraoral osseous discrete traits in six regional samples representing the above populations (n=356). These data were compared using the mean measure of divergence distance statistic and principal components analysis to yield intersample phenetic affinities, and the identification of traits driving intersample variation. Comparative results indicate that: 1) phenetic heterogeneity is evident among the samples; 2) the presence of Celtic material culture in Etruscan and Picenic populations was primarily the result of a cultural transition; 3) the Picenis and Etruscans retained a degree of cultural autonomy and genetic divergence from the invading Celts; 4) population discontinuity between the Celtic and Picenic populations is suggested. Thus, a degree of population discontinuity among the Celts, Etruscans, and Picenis is supported, and greater phenetic heterogeneity among populations possessing Celtic material culture during the Iron Age is implied.

Conflict at Kaman-Kalehöyük: The End of the Middle Bronze Age at a Rural Settlement in Central Anatolia

CHERYL P. ANDERSON[1], LEVENT ATICI[2] and SACHIHIRO OMURA[3]

[1]Anthropology, Boise State University, [2]Anthropology, University of Nevada, Las Vegas, [3]Archaeology, Japanese Institute of Anatolian Archaeology

Archaeological and textual evidence from the end of Middle Bronze Age (ca. 2000-1750 BCE) in central Anatolia (present-day Turkey) suggests a landscape of turmoil associated with the collapse of the Assyrian trading system and the establishment of the Hittite Empire. Excavations at a rural MBA community, Kaman-Kalehöyük, have unearthed the human skeletal remains of a minimum of 64 individuals, many of which are burned and associated with burned rooms. The context of these burned individuals, including the presence of weapons, has led the excavators to interpret these individuals as the victims of a battle. However, previous analyses of some of the human skeletal remains has not identified clear examples of perimortem trauma. This research performed a detailed analysis of all the human skeletal remains dating to the end of the MBA in order to assess whether or not skeletal evidence for violence is present.

The results of this research demonstrate that at least 3 individuals (4.69%) exhibit perimortem trauma consistent with violence. Of these, 2 individuals have perimortem chop marks consistent with a sharp weapon. The 3rd individual displays perimortem blunt trauma to the left radius. In addition to perimortem trauma, 5 individuals (7.46%) display evidence of antemortem trauma indicative of violence. Of these, 4 have blunt injuries to head or face and the 5th has healed sharp trauma. Taken together, these results confirm that the individuals in the burned layer are likely the victims of violence and demonstrate that interpersonal violence was not limited to this attack.

Assessment of an associated partial skeleton of *Paracolobus mutiwa* (Leakey, 1982) from West Turkana KNM-WT 16827

MONYA ANDERSON

Anthropology, University of Oregon

Paracolobus mutiwa is a large-bodied colobine known from eastern Africa at sites ranging from approximately 2.7-1.9 Ma, and is represented by numerous craniodental specimens. KNM-WT 16827 is an associated partial skeleton from the Lomekwi Member of the Nachukui Formation, West Turkana that has been dated to approximately 2.6Ma (Harris et al., 1988). It is craniodentally similar *P. mutiwa* from Koobi Fora and Omo and the most complete specimen attributed to this taxon. The only comparably preserved specimen of this genus is KNM-BC-3 the holotype of *Paracolobus chemeroni*. Body mass estimates for *P. mutiwa* are larger than those for *P. chemeroni* although it has been noted that the positive allometric scaling of the dentition and cranium relative to the postcrania may overestimate this range (Delson et al., 2000).

Postcranially KNM-WT 16827 is distinct from contemporaneous fossil colobines on several features. Its body mass overlaps with *Rhinocolobus*, but the latter retains more arboreal features of the humerus and ankle. Compared to *Cercopithecoides williamsi,* KNM-WT 16827 is

larger and lacks the distinctly terrestrial features seen in *C. williamsi,* especially of the elbow. Compared to *P. chemeroni*, WT 16827 is smaller in its forelimb and ankle, but the proximal femur has more robust muscle attachments. Interestingly, the forelimb and ankle possess several features that are distinct from BC-3, the other large-bodied fossil colobines, and many extant taxa. This is an important specimen not just for its preservation, but for what it may reveal about the diversity of primate taxa during the Late Pliocene.

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Subadult sex estimation using multi-slice computed tomography scans of the ilium

NATALIE L. ANDRAS[1] and MICHALA K. STOCK[2]

[1]Department of Biology, John Carroll University, [2]Department of Anthropology, University of Florida

Sex estimation is an important aspect of the biological profile because it allows for sex-specific methods to be used in age, ancestry, and stature estimation. However, few sex estimation methods exist for subadult individuals, and, oftentimes yield inconsistent. These inconsistences may be the byproduct of analyzing insufficient traits per study, employing nonmetric traits, and using historic samples. The present study aims to remedy some of the aforementioned issues by using multi-slice computed tomography (MSCT) scans of modern, subadult males and females to metrically examine size and shape differences of the ilium for sex estimation.

Fifty-six subadult MSCT scans of known sex and age were sampled from the University of New Mexico Health Sciences Center, Office of the Medical Investigator: 22 females and 34 males between the ages of one day to one year old. Using Geomagic, eleven landmarks were collected from the left ilium. Jackknifed linear discriminant function analyses using interlandmark distances, Procrustes coordinates, and principal components were used to assess classification accuracy.

Males were significantly larger than females ($p<0.05$), and classification accuracies ranged from 59.1% - 73.53%. Classification accuracies using interlandmark distances and Procrustes coordinates were comparable, and principal components provided the greatest classification accuracy. The results of this study suggest significant differences exist between the subadult ilium of males and females; however, the use of a larger sample size and/or analyses using the ilium in conjunction with the ischium and pubis may provide higher classification accuracies.

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New adapoid material (Primates, Adapiformes) from the Great Divide Basin of southwestern Wyoming

ROBERT L. ANEMONE, JORDAN CROWELL and BRETT NACHMAN

Anthropology, University of North Carolina at Greensboro

Early Eocene fossil-bearing deposits from intermontane sedimentary basins in the American West often preserve the remains of two superfamilies of early primates, the Adapoidea and Omomyoidea. Decades of paleontological and geological work in the Bighorn Basin of northern Wyoming have yielded an unparalleled local biostratigraphic record of evolutionary change in both adapoids and omomyoids which is often assumed to reflect regional or even continental patterns of evolutionary change in these lineages. Here we describe the fossil sample from the Great Divide Basin (GDB) and compare it to the sequence of adapoid evolutionary change described in the Bighorn Basin (BHB), situated approximately 300 miles to the north, in order to test for faunal and biostratigraphic differences in the Early Eocene of Wyoming. We examined and measured holotype material for all taxa described here, and summarized all published metric and non-metric diagnoses of BHB adapoid material. We measured all upper and lower molar tooth positions and described all diagnostic non-metric dental features in the GDB sample (N = 550) from 10 different localities. Relative biostratigraphic position for each GDB locality was determined by geological correlation in the field and confirmed by the presence of index taxa as well as by typical associations of species known from other basins in the region. Our results indicate that, while patterns of body size evolution over time are generally similar, non-metric dental features in the two samples can vary significantly, suggesting that latitudinal differences should be taken seriously when comparing fossil assemblages across space.

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Diet Metabarcoding and Conservation of Tonkin Snub-nosed Monkey in Vietnam

ANDIE ANG[1,2], AMRITA SRIVATHSAN[3], BACH TUONG. LUU[4], QUYET KHAC. LE[5], RUDOLF MEIER[3] and HERBERT COVERT[1]

[1]Anthropology, University of Colorado Boulder, [2]Raffles' Banded Langur Working Group, Singapore, [3]Biological Sciences, National University of Singapore, [4]Wildlife Consultant, Vietnam, [5]Saola Working Group, Vietnam

Characterizing the diet of an endangered primate is essential for structuring effective management plans for its conservation. Conservation measures such as choosing areas for protection or species to be planted for remediation of degraded habitat can be guided if food plants are known. Obtaining this information through direct field observation, however, is challenging especially for rare and unhabituated primates in less accessible locations or difficult terrains. Alternatively, molecular genetic methods can be employed to complement observational study so that food items can be identified in a relatively shorter period of time. We carried out DNA metabarcoding in association with next-generation sequencing to identify the diet of critically endangered Tonkin snub-nosed monkeys (*Rhinopithecus avunculus*, TSNM) in Khau Ca Area, Vietnam. A total of 217 fecal samples were collected and plant sequences of consumed items were amplified using trnL primers. Eighteen families were recorded from the TSNM fecal samples, with Annonaceae found in all 217 samples, followed by Lauraceae and Sapotaceae. The dominant taxon belonged to *Polyalthia* (Annonaceae) and they were also the dominant genus and family respectively within Khau Ca Area. Three families, eight genera and three species were new records such that there are currently 61 food plant taxa identified for TSNM based on observations and metabarcoding. This research highlights the importance of using genetic methods to complement field observations so as to better understand dietary profiles in order to identify priority actions for their conservation.

This project was funded by Mohamed bin Zayed Species Conservation Fund, Wildlife Reserves Singapore Conservation Fund, Beverly Sears Graduate Student Research Grant, and University of Colorado Boulder.

The AAPA IDEAS program: influence on a science

SUSAN C. ANTÓN[1], RIPAN S. MALHI[2] and AGUSTÍN FUENTES[3]

[1]Anthropology & CSHO, New York University, [2]Anthropology & Animal Behavior, University of Illinois Urbana-Champaign, [3]Anthropology, University of Notre Dame

The NSF-funded AAPA IDEAS Program (Increasing Diversity in Evolutionary Anthropological Sciences) hosts an interconnected series of workshops, mentoring and outreach efforts designed to raise the profile of the discipline among minority students, build mentoring networks and broaden the dialog at the AAPA meetings. We review demographic data which show that tenure-line faculty in Biological Anthropology are similar to those of the most non-diverse of the Natural Sciences (including Zoology, Geology, Ecology and Evolution) and are less diverse than both Biology and Anatomy. Because quantitative research demonstrates that diverse groups do better science, and for reasons of social justice, we should strive to achieve a composition of scholars that is more inclusive of diverse backgrounds/experiences. To

increase representation Biological Anthropology must be proactive in supporting scholars with diverse views and experiences, and students of color must find themselves drawn to Biological Anthropology as a career. Because students are unlikely to choose a career with which they are unfamiliar, IDEAS conducts outreach at societies dedicated to the advancement of minorities in science (e.g., SACNAS.org). To counter the lack of culturally accessible role models, IDEAS hosts a YouTube channel featuring videos produced with the BOAS network. To build strong professional networks, IDEAS offers a pre-meeting workshop which includes research presentations and discussions, professionalization modules and networking activities. Workshop success is assessed by I-STEM, UIUC. The IDEAS program broadens the dialog at the AAPA meetings with its discussion panels and has opened a space for both formal and informal member programming on diverse topics.

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Skeletal morphology of the lesula (*Cercopithecus lomamiensis*) suggests multiple transitions to terrestriality in the guenon radiation

JULIA L. ARENSON[1,2], CHRISTOPHER C. GILBERT[1,2,3], ERIC J. SARGIS[4,5], KATE M. DETWILER[6], TERESE B. HART[5,7] and JOHN A. HART[5,7]

[1]PhD Program in Anthropology, The Graduate Center, CUNY, [2]New York Consortium in Evolutionary Primatology, New York, NY, [3]Department of Anthropology, Hunter College, CUNY, [4]Department of Anthropology, Yale University, [5]Division of Vertebrate Zoology, Yale Peabody Museum of Natural History, [6]Department of Anthropology, Florida Atlantic University, [7]Lukuru Wildlife Research Foundation, Kinshasa, Gombe, DRC

The living guenons (Tribe Cercopithecini) are largely an arboreal radiation, but the recognition of patas, vervets, and L'Hoest's monkeys as a clade suggests a single evolutionary transition to terrestriality within the tribe. Recently, a new guenon species was discovered in the TL2 region of the Democratic Republic of the Congo, the lesula (*Cercopithecus lomamiensis*). Little is known about its behavior and morphology, but preliminary observations and camera trap data suggest that the lesula is frequently found on the forest floor. The recovery of two skeletal specimens allows for evolutionary morphological analyses of the lesula postcranium and the guenon radiation more broadly.

Twenty-one qualitative features and quantitative measurements correlated with terrestriality were taken on 151 individuals representing 22 guenon species, including *C. lomamiensis*. The percent of time spent on the ground was taken from the literature for each species, and every species was also assigned a categorical terrestriality score (arboreal: <20%; semi-terrestrial: 20-40%; and terrestrial: >40% on the ground). Size-corrected and species-averaged measurements were included in a principal components analysis. PC1 was highly correlated with percent terrestriality (R^2 = 0.844, $p < 0.001$), and this regression estimated the lesula spends 39-52% of its time on the ground. A discriminant function analysis correctly classified 87.6% of specimens to locomotor category, and classified the lesula specimens as semi-terrestrial (posterior probability = 0.968) or terrestrial (posterior probability = 0.997). These results corroborate field observations of the lesula and its sister species, *C. hamlyni*, suggesting that terrestriality evolved multiple times among the guenons.

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Evidence for microevolution in enamel growth rates: preliminary results

CHRISTOPHER ARIS, CHRIS DETER and PATRICK MAHONEY

School of Anthropology and Conservation, University of Kent

Reconstructing the cell mechanisms that generate tooth morphology from histology has been an important approach for gaining insights into the evolution of permanent dentition when compared between hominoid species. However, the microevolution of modern human permanent tooth enamel has received limited research. This study uses dental histological thin sections to examine the daily rate that enamel forming cells deposit new matrix (DSR) in samples of permanent molar crowns from two British populations. One sample dates to the early Roman period in Britain (1-4AD)and is compared to a modern day clinical sample. Thirty-two first and second permanent molars were studied: Roman (n=11) and clinical (n=21). Results display a consistent and significant decrease in the lateral enamel DSRs between the two sample populations. Comparisons of mean inner, middle, and outer region DSRs were all significantly lower ($p<0.000$) in the clinical sample (inner=3.08µm/day; mid=3.37µm/day; outer=3.69µm/day) compared to the Roman sample (inner=3.67µm/day, mid=4.19µm/day; outer=4.57µm/day). These data provide the first evidence of a change in the daily rate of enamel growth in human permanent molars in ancient Britain, compared to the modern day. Ongoing PhD research will investigate more British populations that date to the 2000 year period seperating the Roman and Clinical samples.

Environmental Change and African Early to Middle Miocene Catarrhine Evolution

IRISA D. ARNEY[1], LAURA MACLATCHY[1], BRENDA R. BENEFIT[2], MONTE L. MCCROSSIN[2] and JOHN D. KINGSTON[1]

[1]Anthropology, University of Michigan, [2]Anthropology, New Mexico State University

Previous research suggests that changes in mammalian faunas (including the spread of bovids and giraffoids) and in catarrhine adaptive evolution during the African early to middle Miocene transition were influenced by a shift from closed-canopied forests to more open habitats.

To evaluate the extent of habitat change that occurred between the early and middle Miocene, this study compares stable carbon isotope ratios of herbivore tooth enamel ($\delta^{13}C_{enamel}$) from middle Miocene sites (Maboko, Fort Ternan and Kipsaramon) to multiple early Miocene localities. In addition, lower second molar shear crest lengths of 47 early Miocene and 26 middle Miocene noncercopithecoid catarrhines were compared to investigate any dietary change that may have occurred between the early and middle Miocene.

Our results show that by the middle Miocene the relative length of non-cercopithecoid catarrhine shear crests had increased compared to the early Miocene, with nyanzapithecines from Maboko having *Gorilla*-like relative shear crest values, suggesting folivory.

Middle Miocene mammal $\delta^{13}C_{enamel}$ values (Maboko = 86 suids, tragulids, proboscideans, rhinocerotids, hyracoids, giraffoids, bovids; Kipsaramon = 19 proboscideans, rhinocerotids) do not fall within the range of those of modern closed canopied forest herbivores, although some variation in $\delta^{13}C_{enamel}$ values exists between sites. Maboko carbon values (-8.2 to -13.2‰) are lower than those from Kipsaramon (-4.4 to -8.0‰)), possibly indicating a more closed ecosystem. Interestingly, $\delta^{13}C_{enamel}$ values from the early and middle Miocene sites overlap considerably. These data suggest potentially similar broken canopy/woodland habitats at the catarrhine sites sampled thus far during both the early and middle Miocene.

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Diet, Disease, Diversity, and Death: Discoveries within the Yale Peabody Museum African Ape Collection

GARY P. ARONSEN, RYAN T. MCRAE and MEGAN KIRKHAM

Anthropology, Yale University

Museum collections are critical resources for examining comparative anatomy, developmental

biology and life history hypotheses. Evaluation of skeletal collections provides insight into spatiotemporal, species, population and individual variation associated with environmental, social and epidemiological history. For endangered species such as primates, these collections provide data that are nearly impossible to replicate today.

Here we describe aspects of the African Ape skeletal collection within the Peabody Museum of Natural History at Yale University. Our exhaustive review of *Pan* and *Gorilla* skeletal material identifies taxonomic diversity and distribution across captive and wild environments. Multiple age and sex classes are present, with craniodental and postcranial elements available for each age class. All material was assessed for developmental, disease, trauma and socioecological indicators. Multiple indicators of metabolic stress are present and likely associated with nutritional and epidemiological factors. Instances of trauma and injury, ranging from antemortem to perimortem events, are described. For some individuals, these injuries are likely associated with intraspecific and intrasexual competition and violence, whereas others are suggestive of infanticide attempts and predation. Markers of interspecific violence are of value for wildlife and human forensic examination. Our evaluation of the Yale Peabody Museum collection provides a baseline for future research and testable hypotheses for alternate techniques, such as isotopic analyses of calculus and noninvasive genetic testing. Museum collections continue to provide new insights into taxonomic and individual variation and environmental cues, and ultimately allow for comparisons between modern and historical environmental and behavioral variables.

Genetic Footprints of Social Stratification and Codified Caste-Clan System in India

GANESHPRASAD ARUNKUMAR[1], ARUN VS[2], SYAMA A[2], KAVITHA VJ[2] and RAMASAMY PITCHAPPAN[2]

[1]Human Genomics Lab, School of Chemical and Biotechnology, SASTRA University, [2]Department of Immunology, School of Biological Sciences, Madurai Kamaraj University

Indian populations are characterised by their cultural, geographic, linguistic and genetic diversity. Various lines of evidences suggest a deep antiquity of Indian populations. A unique characteristic of the Indian society is the practise of caste system which is characterized by hierarchical grouping of inbreeding populations, in other words caste endogamy. Within each endogamous population (a caste or a tribe) many patrilineal clans exist that follow clan exogamy. The Indian centre of the Genographic Project aimed to decipher the population structure and migratory pattern of Indian populations. Under its aegis a total of 12,040 males were sampled across India and genotyped for a battery of 42 Y-SNPs, 17 Y-STRs, 22 mtDNA SNPs and mtDNA HVS-1 sequencing. The analysis of Y-chromosomal diversity in the south Indian state of Tamil Nadu revealed that social stratification existed before the implementation of the codified Varna caste system dating back to 6 KYa. To test genetic footprints of partilineal clan system 569 samples from 6 populations were analysed. It was observed that irrespective of the caste affiliation, all the populations practised clan exogamy, although the proxy used to classify the clans varied widely. The between clan genetic variation differed widely between various populations. STR evolution within a clan was observed only in few of the clans. Topology of phylogenetic trees suggested fission and fusion events may have occurred at varying degrees in different populations' clans. Over all the data suggested clan evolution to be dynamic process that has been taking place at different rates in different populations.

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Comparing non-human primate microbiomes from multiple body habitats

ABIGAIL E. ASANGBA[1,2], LAWRENCE MUGISHA[3], REBECCA J. LEWIS[4], ALI HALAJIAN[5], STEVEN R. LEIGH[6] and REBECCA M. STUMPF[1,2]

[1]Department of Anthropology, University of Illinois at Urbana-Champaign, [2]Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, Urbana, IL, USA, [3]Department of Wildlife and Aquatic Animal Resources, Makerere University, Kampala, Uganda, [4]Department of Anthropology, University of Texas at Austin, TX, USA, [5]Department of Biodiversity, University of Limpopo, South Africa, [6]Department of Anthropology, University of Colorado-Boulder, Boulder, CO, USA

The study of the primate microbiome has served as a critical tool in understanding the impact of bacterial communities on the health of both human and non-human primates (NHPs). They have been found to play several significant roles in the host organism including providing the necessary metabolic pathways for fiber breakdown, supplying the gut lining with nutrients, and protection from hostile competitors. Microbes have also been associated with metabolic, auto-immune, and infectious diseases. In this study, we collected and analyzed rectal, oral, nasal, otic, vaginal and penile swabs from 13 non-human primate species, the majority of which were wild. Using 16S rRNA sequencing, we compared the microbiome of all samples. Within host species, microbiomes clustered distinctly by body habitat, with lower within-body habitat diversity than between-body habitat diversity mainly due to the strong niche specializations observed. Even captivity did not appear to have a large effect on microbial composition as samples still clustered by body habitat. Analyses of all body habitats across primates demonstrated that microbial diversity was lowest in the oral samples and highest in the rectal samples. Notably, the oral microbiome clustered and diverged the most of all body habitats, suggesting a distinct and relatively conserved oral microbiota across NHPs. These results help elucidate the wide variation present in the microbiomes from various body habitats both within and between NHPs. Further studies are needed to better understand the functions of the specific microbial species comprising the oral microbiome as they appear to be highly conserved across NHPs.

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Breastfeeding and the Appearance of Choice

IFEYINWA ASIODU

Family Health Care Nursing, University of California, San Francisco

Breastfeeding provides physiological, psychological, and immunological benefits for mothers, lactating persons, and infants and economic benefits for society. Breastfeeding is a particularly important public health issue in the Black community which is disproportionately impacted by poor birth outcomes such as premature birth, low birthweight, infant mortality and high rates of cardiovascular disease and type-2 diabetes. While human milk is considered the gold standard of infant feeding in the United States (US), racial disparities in breastfeeding (and the provision of human milk) persist. A majority of Black mothers are not exclusively breastfeeding their infants. Breastfeeding is often presented as a choice made by the birthing person. Given the cultural, historical, institutional and structural issues associated with breastfeeding in the US, many Black mothers may not have the support and resources necessary to carry out their preferred choice and meet their infant feeding goals. This presentation will provide a synthesis of barriers to and facilitators of breastfeeding in the Black community, drawn from my own research as well as state data and state and federal policies. In particular, I will present suggestions for social media strategies to provide virtual education and support both for breastfeeding persons and members of their social support networks. Finally, I argue that public health measures aimed at reducing the current infant feeding disparities would benefit by also incorporating more culturally inclusive messaging around breastfeeding and lactation. In order to improve exclusive breastfeeding rates, we must advocate for additional social and structural changes which are supportive of breastfeeding.

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A test of the patterning cascade model: Carabelli's trait and hypocone expression in dm2-M3 across modern human dental complexes

CLAUDIA M. ASTORINO[1,2], KATHLEEN S. PAUL[3] and SHARA E. BAILEY[2,4]

[1]Department of Anthropology, The Graduate School and University Center, The City University of New York, [2]NYCEP, The New York Consortium in Evolutionary Primatology, [3]Center for Bioarchaeological Research, School of Human Evolution and Social Change, Arizona State University, [4]Center for the Study of Human Origins, Department of Anthropology, New York University

The patterning cascade model (PCM) provides an evolutionary framework for predicting cusp number and size in multicuspid teeth. The PCM predicts that when enamel knots – the sites of future cusp tips – are closely spaced and tooth germ size is large, more and larger accessory cusps will form. Previous tests of the PCM in humans have focused primarily on Carabelli's trait (an accessory feature in upper molars) in European populations, who exhibit high expression of this trait. This study tests the accuracy of PCM predictions in Carabelli's and hypocone expression across recent human geographic populations (n = 700). We also expand testing the PCM to include M3 in analysis.

Kruskal-Wallis tests showed significant differences (p = 0.05) in comparisons between European-Asian, Asian-African, and European-African dental complexes, for both Carabelli's trait expression in dm2-M2 and for hypocone expression in M1 and M3. Proportional odds logistic regression showed non-significant relationships between hypocone expression and Carabelli's expression for dm2-M3, although a positive relationship trend between these variables was exhibited in dm2 and M1, in which Carabelli's and hypocone expression tends to be strongest. Three out of four pairs of intercusp distances exhibited significant relationships in one-way ANOVAs for dental complexes and tooth types (but not their interaction); however, despite negative relationship trends in dm2 and M1, these intercusp distances exhibited non-significant relationships when regressed against Carabelli's expression or hypocone expression. These results support previous studies in showing mixed support for the PCM in human accessory cusp traits.

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Aging the Aged: A Modified Method to Age Elderly Individuals Using Osteoarthritis of the Sternoclavicular Joint

ASHLEY M. ATKINS[1,2] and ISABELLE DE GROOTE[2]

[1]Anthropology, University of Hawaii at Manoa, [2]Forensic Anthropology, Liverpool John Moores University

Osteoarthritis appears in the sternoclavicular joint after the fifth decade and majority of individuals will show osteoarthritic signs of degeneration in the joint. Using this joint can thus help to age the skeletal remains of an elderly individual whose age estimations are often open-ended "over 50" ages. This study modifies the Falys and Prangle scoring system (2014) to score three morphological traits (surface topography, porosity, and osteophyte formation with regards to lipping) using 180 clavicles of individuals from the St. Bride's Documented Skeletal Collection and 94 clavicles of individuals from the Gloucester collection with the help of written descriptions, photographed examples, and flow charts. We added lipping to the osteophyte formation trait to the Falys and Prangle scoring system to create a Modified F&P method. In testing repeatability, osteophyte formation with the addition of lipping was the easiest trait to score consistently.

The scores for the individual traits were summed to form a composite score and used to estimate age using linear regression analyses for samples of unknown sex and known sex for both right and left clavicles. The modified method's regression had an average accuracy of 77%. The results show it is possible to improve age estimation of those over the age of 50 by observing the prevalence of osteoarthritic traits on the sternal end of the clavicle with more accuracy than was previously possible. These findings are significant for aging the aged in comparison to other aging techniques, as this method does not include any open-ended age ranges.

'Go West': East-west gene flow in aye-ayes (*Daubentonia madagascariensis*) supports the western-rainforest refugia hypothesis

MEGAN L. AYLWARD[1], EDWARD E. LOUIS JR.[2], GEORGE H. PERRY[3,4] and STEIG E. JOHNSON[1]

[1]Department of Anthropology & Archaeology, University of Calgary, [2]Bill and Berniece Grewcock Center for Conservation and Research, Omaha's Henry Doorly Zoo and Aquarium, [3]Department of Anthropology, Pennsylvania State University, [4]Department of Biology, Pennsylvania State University

The extent of historic forest cover across Madagascar is largely unknown and likely changed during Pleistocene glacial cycles. Additionally, current lemur species distributions do not reflect their historic ranges. Many lemur species are primarily arboreal and therefore distributions may have shifted along with forest habitat. Currently the central highlands consist primarily of grassland and are almost devoid of lemur species. The western-rainforest refugia model for Madagascar's biodiversity suggests that at times of glacial minima, the eastern rainforest extended west, allowing dispersal of forest-dwelling species across the central highlands. Recent research showed east-west gene flow in both brown and mouse lemur species. We tested for east-west gene flow within aye-ayes, one of the few lemur species that is distributed on both sides of the island. We sampled mitogenomes from seven populations across the aye-aye's geographic distribution and calculated pairwise Fst among all populations. We used migrate-n to test models of gene flow across the central highlands between a population in the west and two populations in the east. We used Bayes factors to assess the relative support for these models. Population differentiation revealed the lowest Fst values between the West and Central-East populations (0.784), and greater differentiation between the more proximate West and North-West populations (Fst 0.959). The best supported model was asymmetric gene flow from east to west. Asymmetric gene flow and lower differentiation for populations either side of the central plateau suggest historic connectivity across the island for aye-ayes, thus offering further support for the western-rainforest refugia hypothesis.

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Caesarean birth and adiposity parameters in 6-to 8 year-old urban Maya children from two cities of Yucatan, Mexico

HUGO AZCORRA[1], LUIS RODRÍGUEZ[2], SUDIP DATTA BANIK[1], BARRY BOGIN[3], MARIA INES VARELA-SILVA[3] and FEDERICO DICKINSON[1]

[1]Department of Human Ecology, Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, [2]Facultad de Matemáticas, Universidad Autónoma de Yucatan, [3]Centre for Global Health and Human Development, Loughborough University

Birth mode is a factor with implications for immediate and future health in infants and children. Studies show higher values of BMI in children born by caesarean section (CS) in comparison with individuals vaginally delivered (VD), suggesting a possible association between CS and increased risk of obesity. However, few studies have reported on this aspect. We analyse the association between CS and fat mass index (FMI), waist-to-height ratio (WHr) and sum of tricipital, subscapular and suprailiac skinfolds (SumSkfs) in a sample of 256 urban Maya girls and boys from Yucatan, Mexico (ages 6 to 8 year-old). From 2011 to 2014, we measured height, weight, waist circumference and skinfolds in these children, and height and weight in their mothers as well. Body composition was estimated in both generations through bioelectrical impedance analysis. Multiple regression models for boys and girls were used to analyze the influence of CS on adiposity parameters adjusting for the effects of child's age, birth weight, breastfeeding duration, age of introduction of solid foods, and

maternal fat mass (FM). CS was associated with higher values of FMI in girls only, but not with any other proxies of fatness. Standardized coefficients showed that maternal FM was the most important predictor of child fatness, followed by the influence of CS. Our results partially support the hypothesis that CS is associated with higher body fatness and that girls may be more sensitive to birth mode than boys.

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Foraging and spatial behavior of *Alouatta palliata* in the edge and interior of a Costa Rican forest fragment

MADISON L. AZZARA[1,3], AMY L. SCHREIER[2,3], ZACHARY S. JACOBSON[3,4], DORIAN G. RUSSELL[3,5], ELIZABETH A. SHEEHAN[2,3], RENATE M. SCHLAHT[2,3] and LAURA M. BOLT[3,6]

[1]Biology, James Madison University, [2]Biology, Regis University, [3]Maderas Rainforest Conservancy, [4]Anthropology, Grand Valley State University, [5]Environmental Science, American University, [6]Anthropology, University of Toronto

Forest fragmentation is a major threat to primate populations globally. Although studies have shown that foraging and spatial behavior are affected by fragment size, little is understood about changes in feeding and spatial cohesion within a fragment. This study examines foraging and spatial behavior of *Alouatta palliata* in the edge and interior of a forest fragment at the La Suerte Biological Research Station, Costa Rica. We hypothesized that *A. palliata* would spend more time foraging in the forest interior compared to the forest edge because there is higher food availability in the interior. Consequently, when foraging in the interior, *A. palliata* will be in closer proximity to their nearest neighbor than when on the edge. From May–August 2017, we collected behavioral data and estimated the distance in meters between focal individuals and their nearest neighbor. We also conducted vegetation transects and calculated tree species richness and diameter at breast height (DBH). Mean tree species richness was significantly higher in the interior (6.1trees/m^2) than the edge (3.8), as was DBH (42.0cm vs 29.2cm, respectively). While *A. palliata* spent more time foraging in the interior (13.5%) than the edge (12.1%), the mean distance between nearest neighbors when foraging in the edge (3.0m) was lower than in the interior (4.0m); these differences, however, were not significant. These results suggest that *A. palliata* at La Suerte have adjusted to an anthropogenically-altered forest and compensate for lower food availability in the edge in ways other than modifying their foraging time and spatial cohesion.

Craniofacial integration and evolution of hominins

KAREN L. BAAB

Anatomy, Midwestern University

Phenotypic covariance reflects the endpoint of complex developmental processes, including genetic factors, epigenetic interactions and growth. Both trait variance and covariance (i.e., integration) determine evolvability, particularly at a microevolutionary scale. This study investigates the role of craniofacial integration in shaping patterns of intraspecific variation in modern humans, and whether phenotypic variance and covariance have constrained evolution in the genus *Homo*.

The directions of maximal variance and covariance were closely aligned in modern humans based on 3D landmarks acquired from a globally diverse sample of ~300 recent human crania. This is consistent with previous studies demonstrating the pivotal role of neutral evolution in recent human cranial evolution. To evaluate whether variance and covariance also impacted diversification within the genus *Homo*, I calculated evolvability and conditional evolvability based on the modern human variance/covariance matrix in directions of shape change at putative speciation events involving *Homo erectus*, *H. heidelbergensis,* early *H. sapiens* and *H. neanderthalensis*. Species divergences during the evolution of *Homo* were not aligned with the maximal direction of variance (evolvability), but generally occurred in directions of above-average evolvability. This finding implicates the role of natural selection during lineage formation if the modern human pattern is broadly representative of craniofacial variance / covariance throughout the evolutionary history of *Homo*, but does not rule out the role of genetic and developmental constraints.

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Tempo and mode of gene expression evolution in the brain across the primate tree

COURTNEY BABBITT[1], TRISHA M. ZINTEL[1], JOHN J. ELY[2], MARY ANN RAGHANTI[3], WILLIAM D. HOPKINS[4,5], PATRICK R. HOF[6,7], CHET C. SHERWOOD[8] and AMY L. BAUERNFEIND[10,9]

[1]Biology, UMass Amherst, [2]Alamogordo Primate Facility, Holloman Air Force Base, [3]Department of Anthropology, Kent State University, [4]Neuroscience Institute and Language Research Center, Georgia State University, [5]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center, [6]Fishberg Department of Neuroscience and Friedman Brain Institute, Icahn School of Medicine at Mount Sinai, [7]New York Consortium in Evolutionary Primatology, [8]Department of Anthropology and Center for the Advanced Study of Human Paleobiolog, The George Washington University, [9]Department of Neuroscience, Washington University School of Medicine, [10]Department of Anthropology, Washington University in St. Louis

Primates exhibit remarkable diversity in behavioral specializations, including those pertaining to social structure, spatial, dietary and visual ecology, and locomotion. Changes in gene expression levels within specific brain regions may be associated with differences in behavioral phenotypes across primates, however, brain gene expression has been examined in a very limited number of species to date. To understand better how changes in gene expression in the brain have evolved within the primate lineage, we have generated and analyzed RNA-Seq data from 18 primate species (including 5 apes, 4 Old World monkeys, 4 New World monkeys, and 5 strepsirrhines) across 4 brain regions (dorsolateral prefrontal cortex, hippocampus, primary visual cortex, and lateral cerebellum). We measured 15,017 orthologs within apes, and 3,432 orthologs across all 18 sampled primates, and found that ~15-20% of genes show differential expression across various species contrasts. Gene expression distance matrices were used to assess evolutionary trends in primate brain. For each region of interest, gene expression phylogenies predicted relatedness of species based on pair-wise correlations. We also performed tests of adaptive shifts in specific genes in individual lineages. Genes with high expression divergence between species are candidates for expression level adaptation. These data provide us with unprecedented phylogenetic coverage to survey the changing landscape of gene expression in the primate brain over its evolutionary history.

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Habitat degradation and proximity to villages explain population structure in Critically Endangered black-and-white ruffed lemurs (Varecia variegata)

ANDREA L. BADEN[1,2,3], AMANDA N. MANCINI[2,3], SARAH FEDERMAN[4], JASON M. KAMILAR[5], SHEILA HOLMES[6], STEIG E. JOHNSON[6], EDWARD E. LOUIS, JR[7] and BRENDA J. BRADLEY[8]

[1]Anthropology, Hunter College - CUNY, [2]Anthropology, The Graduate Center - CUNY, [3]NYCEP, [4]Ecology & Evolution, Yale University, [5]Anthropology, University of Massachusetts, Amherst, [6]Anthropology & Archaeology, University of Calgary, [7]Center for Conservation and Research, Henry Doorly Zoo, [8]Center for the Advanced Study of Human Paleobiology, George Washington University

Madagascar is characterized by exceptional species diversity and endemism, much of which is threatened by habitat fragmentation due to anthropogenic activities. Black-and-white ruffed lemurs (*Varecia variegata*), a Critically Endangered arboreal obligate frugivore that thrives almost

exclusively in primary rainforest habitats, may be at particular risk. Recent work has identified geographic structuring in the genetic diversity present among current ruffed lemur populations; however, the primary landscape features driving these patterns have not yet been identified. Here, we use a landscape genetics approach to test the hypothesis that anthropogenic pressure (e.g., conversion of ruffed lemur habitat into agricultural land, proximity to villages) has influenced the genetic structuring of ruffed lemur populations. We evaluate the impacts of both natural and anthropogenic factors on genetic distance among 18 *V. variegata* sampling localities throughout Madagascar's eastern rainforest corridor. Resistance surfaces were optimized for five landscape features and then ranked against one another through bootstrapping. Our results indicate that both proximity to villages (Avg. rank = 1.56) and habitat type (Avg. rank = 1.80) explain significantly more variation in the observed genetic structure in *V. variegata* than geographic distance alone (Avg. rank = 5.92). These results demonstrate that human activity has significantly impacted the genetic structure of a Critically Endangered lemur and highlight the need for habitat restoration in areas of high conservation value.

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Politics of collaborative research with Indigenous communities: Moving beyond the framework of community engagement

ALYSSA C. BADER[1], SAVANNAH MARTIN[2] and RIPAN S. MALHI[1,3]

[1]Department of Anthropology, University of Illinois at Urbana-Champaign, [2]Department of Anthropology, Washington University in St. Louis, [3]Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign

The history of biological anthropology research in Indigenous communities is one fraught with exploitation and mistrust due to the power imbalance between Indigenous communities and researchers within the Western scientific academy. As part of ongoing efforts to acknowledge and grapple with this legacy, many biological anthropologists have incorporated elements of community engagement and collaboration into their research process. This has been a necessary and positive step in working toward more ethical biological anthropology research practices, by addressing possible differences in worldviews and developing a research program of interest and relevance to both Indigenous communities and scientists. Ideally, building trust between Indigenous communities and predominantly non-Indigenous researchers will help Indigenous communities benefit from Western scientific research advances and will lead to more comprehensive, innovative, and informative research in biological anthropology. While engagement strategies may have increased dialogue between Indigenous communities and researchers, this presentation will discuss why we must push beyond the framework of community engagement to continue challenging the colonial foundations of our field. Drawing on methodological literature from within and beyond anthropology, as well as our own experiences as researchers, we will address how engagement models encourage the researcher to reach "out" to the community, but subtly reinforce the power inequity between researchers and the community. Future models of collaborative and equitable research with Indigenous communities will need to challenge the epistemological biases of the researcher and the field, from the types of research questions we ask, to who has access to research spaces, to what constitutes "data".

The role of substrate property in the development of degenerative joint disease in monkeys

LAURA BAIGES-SOTOS and PIA NYSTROM

Department of Archaeology, University of Sheffield

Primates perform an extraordinary array of locomotor behaviors and exploit different types of habitats. This reflects on differences in body posture that entail different biomechanical requirements for weight-bearing joints. Nevertheless, locomotor behavior has rarely been assessed in previous studies of degenerative joint disease (DJD) in non-human primates. This study explored the relationship between different support use and DJD. The different indicators of DJD were recorded for the main weight-bearing joints of quadrupedal monkeys (N=244) with different strategies of habitat exploitation and support interaction: *Cercocebus agilis*, *C. torquatus*, *Cercopithecus ascanius*, *C. cephus*, *C. nictitans*, *C. pogonias*, *Chlorocebus aethiops*, *Erythrocebus patas*, *Lophocebus albigena*, *Papio anubis*, *Procolobus badius* and *Sapajus apella*. Significant differences ($p<0.05$) were found at the spine, girdles, ankle and wrist when using support use as the grouping criterion, with those species using compliant supports generally showing less degeneration and those species using a mixed assemblage of supports (combining the ground and arboreal supports) showing the greatest values of DJD. Thus different levels of compliance of supports has a critical effect on absorption of impact, decreasing the magnitude of reactive forces and, ultimately, of DJD. However, other intrinsic factors significantly affect the distribution of DJD, as seen with generalized linear models, which also show a significant correlation between body mass and support use, especially in the study of the forelimb. We conclude that DJD is a multifactorial phenomenon, providing a good basis for further studies.

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Estimating Age: Reporting Strategies and Observer Reliability

CHRISTINE A. BAILEY

Anthropology, University of Tennessee

Age-at-death estimation is important for building a biological profile for unidentified human remains. Most anthropologists agree that using data from several aging methods is ideal but difficult since different studies utilize different statistical methodologies. A recent study found that final age ranges are often selected based on experience, by considering the results of aging methods along with individual familiarity of human variation, which does not meet the standards of the *Daubert* ruling. Effects of observer experience on final age results have not been formally quantified. Additionally, inter-observer reliability for different methods is not well understood.

The present study addresses effects of observer experience on age estimation by analyzing final age estimations of 13 observers with varying experience levels. Each observer conducted 6 age-at-death estimation methods and was asked to report result via two comprehensive age reporting approaches (overlap of ranges and experience-based) on two skeletons from the Bass Donated Skeletal Collection at the University of Tennessee, Knoxville. Accuracy of all age ranges was assessed as well as observer agreement between the 13 participants.

Results show that the overlap strategy was more accurate amongst the observers than the experience-based age ranges for both skeletons. However, some individual methods provided more accurate estimations. Cronbach's alpha reliability test indicates that there is excellent agreement between observers with an alpha value of 0.98. Experienced-based age ranges are not the most accurate and different observers score consistently with regards to one other. These results have implications for producing age-at-death estimations in a forensic context.

Arm-swinging in the red-shanked douc (*Pygathrix nemaeus*) in the Son Tra Nature Reserve, Vietnam

KATIE E. BAILEY[1], DAVID L. CARLSON[1], TRAN VAN BANG[2] and HA THANG LONG[3]

[1]Anthropology, Texas A&M University, [2]Southern Institute of Ecology, Vietnam Academy of Science and Technology, [3]GreenViet Biodiversity Conservation Centre, Da Nang, Vietnam

The doucs (genus *Pygathrix*), a taxon from Southeast Asia, are a member of the Colobinae subfamily. Colobines are typically considered arboreal quadrupeds, however *Pygathrix* is known to exhibit high frequencies (~50%) of arm-swinging behavior in captivity, but little is known about wild douc behavior. Here we present the first study to focus exclusively on locomotion in the wild on the red-shanked douc (*Pygathrix nemaeus*). We specifically examined two questions: 1) what is the rate of arm-swinging within their locomotor repertoire, and 2) given the sexual dimorphism of this species, is there a significant difference in arm-swinging frequency? We predict males will arm-swing more because increased body mass trends towards below branch locomotion. Data was recorded between November 2016 and April 2017 in the Son Tra Nature Reserve, Da Nang, Vietnam. This time frame encompasses the wet and dry seasons, ruling out seasonality biases. Using a Canon handheld video camera, the monkeys were recorded between dawn and dusk, five days a week. Following the field season, data was extracted from all footage and recorded in a spreadsheet. All data analysis was conducted in R. Preliminary results show doucs use the following locomotor behaviors at the respective frequencies: arm-swinging (21.5%), quadrupedal walking (24%), leaping (20.5%), climbing (17%), dropping (8.8%), other (6.6%), quadrupedal running (0.9%), and bipedal walking (0.6%). Additionally, early results indicate no significant difference in arm-swinging frequency between males and females. Given the rarity of this primate, it is crucial to inform conservation agencies about its habitat use.

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Teeth on trial: What can dental morphology really tell us about hominin phylogeny?

SHARA E. BAILEY[1,2], LUCAS K. DELEZENE[3,4], JACOPO MOGGI-CECCHI[5] and MATTHEW M. SKINNER[2,4,6]

[1]Center for the Study of Human Origins, New York University, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [3]Department of Anthropology, University of Arkansas, [4]Evolutionary Studies Institute and Center for Excellence in PaleoSciences, University of Witwatersrand, [5]Laboratori di Antropologia, Università di Firenze, [6]School of Anthropology and Conservation, University of Kent

Results of studies on cusp homology, experimental studies of dental growth and development and the dental morphology of new fossil hominins like *Homo floresiensis* and *H. naledi* force us to re-examine to what extent we can rely on dental morphological data to reconstruct evolutionary relationships. *H. floresiensis* has primitive deciduous lower canines and primitive permanent lower third and fourth premolars. However, its small, four-cusped lower molars are morphologically derived towards *H. sapiens*. Rather than indicating a unique phylogenetic link with *H. sapiens*, it is possible that the simplified molars of *H. floresiensis* are a result of diminutive tooth size, similar to that seen in the Middle Pleistocene hominins from Sima de los Huesos. But what about the opposite end of the spectrum? The talonid expansion observed in *Paranthropus* lower deciduous molars and lower permanent premolars and molars has been traditionally understood as derived characters that link *P. robustus* and *P. boisei* into a monophyletic clade. However, certain dental morphological characteristics of *H. naledi* force us to question this interpretation. The permanent lower third premolar and six out of nine deciduous teeth represented by that sample show greatest morphological similarity to *P. robustus* and/or *A. africanus* (ui1, li2, lc, udm1, ldm1 and ldm2). Yet, a number of other morphological traits are derived towards later *Homo* (e.g., lack of upper and lower molar accessory cusps) or unique within the hominin clade (upper molar cusp height and spacing). Here we present alternative ways to interpret these conflicting signals.

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Investigating region-specific natural selection and admixture-associated selection in the Indigenous peoples of the Americas

CHRISTINA M. BALENTINE[1,2], AUSTIN W. REYNOLDS[1,2], AIDA MIRÓ-HERRANS[2], JAIME MATA-MÍGUEZ[2], MARGARITA RZHETSKAYA[3], JENNIFER A. RAFF[4], M. GEOFFREY HAYES[3,5,6] and DEBORAH A. BOLNICK[2,7]

[1]Department of Integrative Biology, The University of Texas at Austin, [2]Department of Anthropology, The University of Texas at Austin, [3]Division of Endocrinology, Metabolism, and Molecular Medicine, Department of Medicine, Northwestern University Feinberg School of Medicine, [4]Department of Anthropology, University of Kansas, [5]Center for Genetic Medicine, Northwestern University Feinberg School of Medicine, [6]Department of Anthropology, Northwestern University, [7]Population Research Center, The University of Texas at Austin

North and South America are home to a large diversity of environments. From the cold Arctic to warm tropical rainforests and high-altitude regions in South America, the Indigenous peoples of the Americas have adapted to and thrived in numerous ecological environments. Regional studies have identified signals of natural selection in specific environmental contexts, such as adaptation to high-altitude in the Andes and adaptations to cold and diet in the Arctic. However, no study has yet taken a wide lens to explore regional patterns of genetic adaptation throughout the Americas. Here, we present a meta-analysis of natural selection throughout the Americas using new and previously-published genome-wide data to identify new signals of adaptation in Indigenous populations.

We gathered genome-wide SNP data from 873 Indigenous individuals from populations in North, Central, and South America. We utilized the Population Branch Statistic to identify signals of natural selection in these groups, using the CHB population (1000 Genomes Project) as our outgroup. To address the confounding effects of admixture, we conducted ADMIXTURE analyses and incorporated data from published ancient genomes. We also used RFMix to explore differential levels of admixture across the genome in order to investigate signals of admixture-associated selection. Finally, we conducted simulations using fastsimcoal2 to assess whether any of the observed genetic patterns could have been caused by drift rather than selection. We discuss our results in the context of local and regional environmental adaptation, migration, and other historical processes that have shaped the genomes of Indigenous individuals in the Americas today.

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Urea concentration as a measure of protein balance in pre- and post- release Bornean orangutans (*Pongo pygmaeus wurmbii*)

ELIZABETH F. BALLARE[1,3] and ERIN R. VOGEL[1,2,3]

[1]Graduate Program in Ecology and Evolution, Rutgers, The State University of New Jersey, [2]Department of Anthropology, Rutgers, The State University of New Jersey, [3]Center for Human Evolutionary Studies, Rutgers, The State University of New Jersey

Orangutans experience variation in protein and total caloric intake throughout the rehabilitation and release process. This can lead to changes in protein balance, reflected in urinary urea concentration, the main breakdown product of protein metabolism. While orangutans receive a supplemented diet of fruit and vegetables during rehabilitation, they face considerable challenges foraging in an unfamiliar habitat with inconsistent food production upon release. Yet, we know very little about how the rehabilitation process influences nutritional status in these individuals. Here, we examined urea concentration in three populations of rehabilitated and released orangutans to better understand whether newly released individuals are acquiring sufficient dietary protein and how protein balance varies throughout the rehabilitation process. We quantified urea concentration (mg/dL) from non-invasively

collected urine samples from orangutans (*Pongo pygmaeus wurmbii*) at the Borneo Orangutan Survival Foundation Nyaru Menteng Rehabilitation Center and Bukit Batikap Conservation Release Forest in Central Kalimantan, Indonesia. Urine samples were analyzed via colorimetric assay following QuantiChrom Urea Assay Kit (DIUR-100) protocol. GLMMs were run in R, controlling for sex, age-class, and population. Individual identity was modeled as a random effect. Preliminary results indicate that urea concentration varied among populations, with the Nyaru Menteng caged population characterized by lower urea concentrations compared to the Nyaru Menteng practice-release island and Bukit Batikap release populations (p=0.045). Based on these results, released individuals are likely obtaining sufficient dietary protein demonstrated by excess urea excretion. Released individuals may achieve their protein goals by consuming a large proportion of leaves in their diet upon release.

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Browridge size and shape variation in *Homo erectus* and *Homo neanderthalensis*: a quantitative assessment using an extant hominoid reference sample

KATHARINE L. BALOLIA

School of Archaeology and Anthropology, The Australian National University

Browridge morphology varies among extinct hominins, with prominent browridges most commonly found in *Homo erectus sensu stricto* and in later hominins. To date, little work has been done to investigate extinct hominin browridge expression in a comparative context. In this study, I quantitatively assess browridge size and shape variation in *H. erectus sensu stricto* and *H. neanderthalensis* using data obtained from 3D surface scans. I investigate whether browridge size variation in *H. erectus sensu stricto* and *H. neanderthalensis,* respectively, is comparable to variation found in five extant hominoid taxa (*H. sapiens*, *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus* and *Hylobates lar*). I examine browridge sexual shape dimorphism in extant hominoids and assess whether the patterns of intraspecific browridge shape variation in *H. erectus sensu stricto* and *H. neanderthalensis* are similar to one or more extant hominoid taxon. Browridge size variation in *H. erectus sensu stricto* and *H. neanderthalensis* does not exceed that observed in extant hominoid species. Among hominids, a similar pattern of 'male-typical' and 'female-typical' morphology is found, where males have a relatively thick middle supraorbital region relative to females, and *P. troglodytes*, *G. gorilla* and *P. pygmaeus* males have a more flaring lateral browridge compared to females. *Homo erectus sensu stricto* and *H. neanderthalensis* show similar patterns of shape variation to what is found in extant hominids. These results suggest that extant hominid taxa may serve as good reference models for interpreting patterns of browridge size and shape variation in extinct hominins.

Cranial trauma in an early 20th Century Asylum: Injury recidivism in the Mississippi State Asylum assemblage

PETRA BANKS and ANNA OSTERHOLTZ

Department of Anthropology and Middle Eastern Cultures, Mississippi State University

This study examined the crania of 68 individuals who died while patients at the Mississippi State Asylum in the early 20th Century. Of 54 individuals included in the analysis, 21 individuals exhibit cranial depression fractures (CDFs), with higher frequencies of CDFs found on the right sides of the crania with large fractures centering on the right frontal. All traumatic lesions are located on or above the hat brim line, which is associated with a higher probability of interpersonal violence. High numbers of trauma are focused on the frontal above the right orbit, and near the right parietal boss. In 10 of these cases, individuals had multiple trauma, which are indicative of possible recidivism. While males and females experienced equal trauma overall, females experienced a higher percentage of multiple trauma. Middle adults had the highest frequencies of both overall and multiple traumas. While the causes of these trauma are unknown, the clustered locations of the injuries argue for similar etiologies. In the cases with recidivistic trauma, the locations and severity of the injuries may have led to behavioral changes including decreased inhibitions and increased aggression, which can increase the potential for recidivism. It is unclear whether these injuries occurred before or after entering the Mississippi State Asylum, but the prevalence of injuries suggests that either these behavioral changes may have been part of the reason for their admittance to the Asylum or been the result of increased exposure to violence within the Asylum after admittance.

Trabecular bone reinforces cortical bone capability to withstand off-axis loading

MEIR M. BARAK

Biology, Winthrop University

Trabecular bone structural adjustment to external loading (Wolff's law) is believed to optimize tissue architecture with the principle direction of loading. Yet, since each trabecular bone tissue is unique in structure and also easily broken, hitherto it was impossible to test a trabecular sample multiple times in different directions to find if its optimal mechanical orientation correlates with the physiological direction of loading. Here we present a novel approach to determine the stiffness and strength of a trabecular sample in multiple orientations using 3D printing of a cubical trabecular bone sample (4.5 mm^3) from a sheep talus. The same trabecular sample was printed in ten different orientations to the main axes of the bone (tilting increments of 10°, ten samples per orientation to a total of 100 samples) until the original axial axis became the radial axis orientation (a final tilt of 90°). Next, each sample was tested in compression until failure and sample stiffness and strength were recorded. Our results show that contrary to the accepted paradigm, trabecular structure is significantly stiffer and stronger (about 30%-40% more) between 40-80° relative to the axial axis. Our findings point to a possibility that trabecular bone has a major role in maintaining bone integrity when it is loaded off-axis (e.g. a fall or a trauma, hitting the bone from the side). Thus, this study introduces new and unexpected results that may change the way trabecular bone structure-function is understood and alter the use of Wolff's law in the field of anthropology.

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Facing our ancestors. A new method of facial reconstruction using geometric morphometric technique

ALON BARASH[1], DAVID KARASIK[1] and ELLA BEEN[2,3]

[1]Faculty of Medicine, Bar Ilan University, [2]Physical Therapy Department, Faculty of Health Professions, Ono Academic college, [3]Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University

The human skull usually retains very little information about the specific individual's identity. Virtually restoring the soft facial tissue has been a challenge for many years. Today, soft tissue depth is being assessed from x-ray, ultrasonography, MRI or CT, followed by average soft tissue reconstruction. While this process was used in many forensic and historical cases, it still poses methodological problems, such as the dataset used for reconstruction and even subjective reconstructors' interpretation. Most importantly, as the human face is highly variable, relaying on average tissue depth at few selected points, holds inherent problems.

Here we suggest a new, simple and more accurate method to evaluate the shape of a face from a skull. 30 CT scans of healthy individuals from routine medical imaging were acquired. All skulls and corresponding faces were 3D reconstructed, and 125 equivalent landmarks and semi-landmarks were placed on their surfaces. To explore to covariation between skulls and faces, partial least squares (PLS) method was applied. Next, principal component analysis (PCA) was used,

in order to explore the space-shape relation between skulls and faces.

PLS shows strong covariation between skulls and faces (R=0.85), supporting a connection between the shape of corresponding skull and face. From the PCA, a clear connection is visible between individual skull and its equivalent face, suggesting the possibility to predict the shape of the face from a skull. This method was applied to an early human and a Neanderthal skull in order to appreciate what they look like.

Exploring brain phenotypic outcomes when Zika virus and protein undernutrition interact during early development

JIMENA BARBEITO ANDRÉS[1], PAULA PEZZUTO[2], LUIZA M. HIGA[2], ANDRÉ A. DIAS[3], JESSICA CC. GOMES[1], RICARDO T. LOPES[4], THAÍS M. PIRES DOS SANTOS[4], RODRIGO V. BARBOSA[1], ROBERTO LENT[1], MARIA BELLIO[3], AMILCAR TANURI[2] and PATRICIA P. GARCEZ[1]

[1]Insitute of Biomedical Sciences, Federal University of Rio de Janeiro, [2]Institute of Biology, Federal University of Rio de Janeiro, [3]Microbiology Institute Paulo de Góes, Federal University of Rio de Janeiro, [4]Nuclear Instrumentation Laboratory, Technology Centre, Federal University of Rio de Janeiro

Dysmorphologies result from modifications in particular aspects of developmental network and their study represents a window to understand the role of specific factors and the epigenetic interactions that are essential for normal morphogenesis. Recently, Zika virus (ZIKV) was linked to brain development abnormalities such as primary microcephaly, a severe reduction in brain growth. However, epidemiological reports showed that ZIKV vertical transmission prevalence varies across different geographical regions. *In vivo* animal studies also described different ZIKV susceptibility rates among wild-type and knockout mice. Therefore, it remains to be known the environmental or genetic co-factors that modulate the effect of congenital ZIKV infection on neuroanatomical development. Here we aimed to analyze the role of maternal nutrition as an environmental factor in the emergence of neural phenotypic dysmorphologies after ZIKV infection using a murine model. After chronic protein restriction in pregnant dams, we injected ZIKV at the peak of cortical neurogenesis. High resolution computed tomography and geometric morphometrics were used to quantify a significant reduction of skull ($p<0.01$), brain ($p<0.001$) and particularly cortex ($p<0.001$) size in newborn pups whose mothers were subjected to low protein diet and ZIKV. Immunostaining for neural progenitors, neurons, and microglia markers revealed that the formation of the cortical plate is restricted even prenatally, indicating that diet might play a critical role in the prevalence of ZIKV congenital syndrome phenotypes. In sum, through this study it was possible to quantitatively assess the interaction of a systemic environmental factor and ZIKV in the production of altered brain and skull phenotypes.

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Increased abundance and gene expression suggest brain immune cells shape the neocortex in typical human fetal development

NICOLE L. BARGER and STEPHEN C. NOCTOR

MIND Institute, Psychiatry and Behavioral Sciences, University of California, Davis

The expansion of the neocortex is a core human adaptation. Yet, the cellular developmental processes underlying this phenomenon are poorly understood. Strikingly, later stages of fetal neurogenesis are associated with a substantial increase in brain immune cells, microglia, in the germinal zones (GZ), which house neural stem cells (NSCs). In humans, this pattern is suggested to reflect microglial maturation and migration, but experimental models indicate that microglia may directly regulate neurodevelopment. Is there evidence that microglia actively shape the developing human neocortex?

We used two techniques, multiple immunofluorescence labeling and genomic (differential expression and Gene Ontology) analysis, to address this question. Charting microglial distribution through human fetal cortical neurogenesis revealed a clear increase in microglial density and complexity in the GZ over time. Because microglia are present at low numbers in the cortical plate (CP), we contrasted GZ and CP expression at different ages to question whether microglial presence was associated with heightened immune activity. Across ages, genes expressed higher in the GZ than CP showed significantly over-representation of immune-associated genes. However, upregulated GZ genes expressed only in early development supported NSC structure, while those in later development evidenced enhanced immune activity, weighted towards processes like cytokine signaling. These results suggest that microglia are not passively migrating through the developing human cortex but perform a diverse array of functions derived from their immune status. As such, changes in immune signaling could provide an unexpected mechanism supporting human cortical expansion and should be considered in evolutionary models of human neurodevelopment.

Religious Cultural Competence in Evolution Education (ReCCEE)

ELIZABETH BARNES and SARA BROWNELL

School of Life Sciences, Arizona State University

Evolution is a fundamental concept in the life sciences, including in biological anthropology, but remains a challenging topic even for undergraduate students. Despite a widespread perception among college instructors that teaching the evidence for evolution is sufficient to address resistance to evolutionary theory, research has shown that it is students' religious beliefs, not their understanding of evolution, that best predicts whether students *accept* evolution. Perceived tensions with students' core beliefs may contribute to student alienation in life science classrooms and the exclusion of underrepresented groups in broader science disciplines.

We propose a framework for evolution education that includes a short module explicitly addressing intersections of evolution with religious beliefs. The goals of such a framework are improving attitudes towards evolution and creating more inclusive undergraduate science classrooms while teaching evolution.

In support of this framework, we summarize our findings from several recent peer-reviewed research studies on undergraduate biology instruction. Qualitative analyses of 98 interviews with instructors and students suggest that a key barrier to effective evolution education are differences between instructor and student religious beliefs. These differences can lead to a failure to acknowledge the tensions between evolution and religion and contribute to students' discomfort and resistance to accepting evolution. However, analysis of student surveys pre-post evolution instruction showed a reduction in students' perceived conflict between evolution and religion when the evolution instructors utilized lessons on science as a way of knowing, constructive dialogue about tensions between evolutionary theory and faith, and discussion of religious scientists.

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Quantifying African habitat heterogeneity and mammalian functional diversity with implications for understanding hominin habitats

W. ANDREW BARR[1] and MARYSE BIERNAT[2]

[1]Center for the Advanced Study of Human Paleobiology, George Washington University, [2]School of Human Evolution and Social Change, Arizona State University

Hominin habitats have often been described as 'mosaic' based on the composition of fossil faunal assemblages. When fossil taxa with distinct functional adaptations are found together (e.g., both grazers and browsers) this diversity is often interpreted as reflecting habitat heterogeneity. We aim to test the implicit assumption that functional diversity is positively associated

with habitat heterogeneity in modern mammal faunas.

We compiled modern mammal presence/absence data from the literature for 237 sites in Africa for mammals >500g along with species-average body mass, locomotor and dietary classifications. We computed a distance-based metric of functional richness (FRic), which reflects the volume of functional trait space occupied by each assemblage. We quantified topographic heterogeneity as the coefficient of variation (CV) in elevation for pixels in a 15 km buffer around each central site coordinate. As a proxy for vegetative heterogeneity we used a thematic land-cover classification for Africa and counted the number of distinct non-anthropogenic land cover types in each buffer (patch richness).

Ordinary Least Squares regression results indicate that residual FRic (residuals from regression of FRic on species richness) is weakly positively associated with both patch richness (standardized β=0.26, R^2=0.064, p<0.001) and CV of elevation (standardized β=0.21, R^2=0.041, p=0.001). Species richness alone explains most of the variation in functional richness in our analysis. We conclude that mammalian functional richness is a noisy proxy for habitat heterogeneity and argue for caution in interpreting hominin habitat heterogeneity on the basis of mammal functional diversity alone.

Comparing Frequencies of Pathology and Trauma in Formative and Late Intermediate Period Populations from the Osmore River Valley, Southern Peru

CHRISTOPHER K. BARRETT

Social Sciences, Washtenaw Community College

Observations of pathology and trauma from skeletal collections provide important insights about health, stress, gender specific activities, and about how human populations adapt to their environments. Here we provide a survey of pathology and trauma for the Formative Period site of Roca Verde (1000 BC to 500 AD) and the Late Intermediate period site of Chiribaya Baja (900 to 1350 AD) from the Osmore River Valley of Southern Peru. Data was collected according to the guidelines from Buikstra and Ubelaker (1994) for all adults (Roca Verde: females = 17, males = 11; Chiribaya Baja: females = 38, males = 42). A sum of observations was made for each category of pathology and trauma, and a Fisher's exact test was used to determine if the frequency of these observations differed significantly by sex or by site. No significant differences were observed for abnormal bone shape, size, loss, formation, or for vertebral pathology. Frequency of fractures, porotic hyperostosis and arthritis were significant; males had higher rates of fracture at Roca Verde, females had higher rates of arthritis at Chiribaya Baja, and both males and females at Roca Verde had higher rates of porotic hyperostosis than at Chiribaya Baja. These results suggest that the transition to settled agriculture by populations in the Osmore River Valley resulted in nutritional improvements for both sexes and changing activity patterns for males and females, respectively.

Barking up the wrong tree? Searching for sexual dimorphism in deciduous enamel thickness and density

BJØRN PEARE BARTHOLDY[1], MENNO LP. HOOGLAND[1] and ANDREA WATERS-RIST[1,2]

[1]Archaeology, Leiden University, [2]Anthropology, University of Western Ontario

Finding a reliable nonadult skeletal or dental sex estimation method has proved elusive. A few studies have shown differences in male and female crown sizes, and genes associated with enamel development on the sex chromosomes suggest a theoretical foundation for sexual dimorphism. However, our understanding of sexual dimorphism in the deciduous dentition remains limited.

This study analyses a post-Medieval sample of deciduous canines (n=33) and first molars (n=30) from the site of Middenbeemster, the Netherlands. It includes 19 known-sex nonadults in a total sample representing 35 individuals, ranging from 15 months to 10 years of age. The teeth were scanned using micro-computed tomography (micro-CT). Enamel density and thickness measurements were collected using a self-devised method for fixed-point measurements and computed threshold-based 3D evaluations. Blind testing using K-means cluster analysis was unable to accurately determine male and female groupings. Post hoc testing with a logit model and t-tests also failed to identify any significant differences ($p > 0.05$) between the male and female individuals.

These results suggest that, at least in the examined sample, deciduous enamel thickness and density measurements may represent a 'red herring' in the search for an accurate method of subadult sex estimation. However, further analyses on larger samples with a wider geographic distribution are needed.

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Adding a piece to the jigsaw puzzle: Skin pigmentation genetics of South Asia

CHANDANA BASU

Division of Developmental Biology, The Roslin Institute (The University of Edinburgh)

The journey of our ancestors from the time when they lost their protective fur to the diverse range of skin color is indeed fascinating to explore, and understand how natural selection and other forces might have shaped this phenotypic trait. The burgeoning field of population genetics over the last decades, with its advancements in data acquisition and analysis, is by now a fast-growing active field of scientific enquiry. South Asian genetic landscape, bearing in mind its geographic, linguistic, socio-cultural and skin color diversity, offers an excellent model system to decipher the genetic underpinnings of human skin color variation and for a better understanding of it's evolutionary history. Our expedition involving skin color measurements from ethnic Indians reflected high pigmentation diversity, and further analyses revealed *SLC24A5* as one of the main determinants of their skin pigmentation variation. Besides this, we resequenced 11.74 kb of the *SLC24A5* gene in a global sample set, to assess the world-wide diversity, selection patterns and study the phylogenetic relationships between the populations. We found that light skin associated variant of *SLC24A5*, shared by West Eurasians and South Asians occur on the same haplotype background. Furthermore, assessing the pigmentation diversity patterns of a local region in India led us to examine how strict marriage practices and multi-layered endogamy contribute to the mosaic of skin tones. As we continue our learning about skin pigmentation, it appears to be much more complex and more than just skin deep.

Diet and Culture at the Greek Colony Himera

CHELSEA BATCHELDER[1], LAURIE J. REITSEMA[1], BRITNEY KYLE[2], KATHERINE L. REINBERGER[1], STEFANO VASSALLO[3] and PIER FRANCESCO FABBRI[4]

[1]Department of Anthropology, University of Georgia, [2]Department of Anthropology, University of Northern Colorado, [3]Archaeological Heritage Section, Superintendency of Palermo, [4]Department of Cultural Heritage, Università del Salento

Greek colonization was a period of intense cultural interaction across the Mediterranean, and beyond. Diet, reflecting a personal, routine aspect of culture, can be used to illuminate cultural heterogeneity at ancient colonies. We analyzed stable carbon and nitrogen isotope ratios ($\delta^{13}C$, $\delta^{15}N$) from bone collagen of 75 skeletons from the Greek colony Himera. We consider sex, age, and mortuary style among the general populace (n=38). We also compare the general populace to skeletons associated with two battles fought at Himera (480 and 409BC), believed from historical records, strontium, and oxygen isotope data to comprise Himeran soldiers, foreign allies, and mercenaries (n=37). Results show that like other Greek Mediterranean populations, diet at Himera primarily was based on C_3 plants and terrestrial animals. Low variability in isotopic ratios suggests that a fairly consistent diet, and likely cultural similarities, existed at Himera. No differences between the sexes (p=0.212, 1.164) nor

age groups (p=3.933, 0.442) are found. The $\delta^{13}C$ values for soldiers in the 480 and 409BC battles differ significantly (p<0.001). The 480BC values are highly variable suggesting soldiers from all over the Mediterranean likely had divergent food traditions. Thus, their general Greek identity and need to protect a conceptual frontier land overcame cultural differences. In contrast, the 409BC $\delta^{13}C$ and $\delta^{15}N$ values are extremely close to those of the general populace, suggesting these soldiers had cultural affinities with the local population. These data suggest that a general overarching identity helped the Greek Mediterranean prosper.

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Handedness in seven lemur species at the Duke Lemur Center when presented with a social learning apparatus

CARLY H. BATIST[1] and JESSICA A. MAYHEW[1,2]

[1]Primate Behavior Program, Central Washington University, [2]Department of Anthropology, Central Washington University

Whether the population-level handedness that humans exhibit is the result of a unique coevolution of hemispheric lateralization and complex cognitive processes has led to extensive theoretical debate. Lemurs, the most ancestral primate lineage, can provide insight into the evolutionary origins of hand laterality. Most previous literature suggests a left-hand bias in some lemur species, but this has not been intensely studied in decades. This study examined hand laterality in 48 lemurs across 7 species at the Duke Lemur Center when groups were given apparatuses as part of a broader social learning study. This apparatus required an individual to push or pull open a door to obtain a food reward. Individual handedness indices (HI) were calculated using the equation, *HI=(RH-LH)/(RH+LH)*, where +1 was entirely right-handed and -1 was entirely left-handed. Data analysis was performed in R. The HI's and binomial tests showed significant hand preferences at the individual level. However, Kruskal-Wallis and Spearman's rank correlation tests showed no significant relationship between hand preference and sex, age, group membership, or species. The previous studies suggesting a left-hand bias for lemurs examined handedness during familiar, repetitive actions such as foraging and grooming. The absence of trends in this data suggest that hand preference in lemurs may not extend to more cognitively complex actions such as the ones required for this apparatus. Lemurs may follow a "continue with the hand that was successful first" heuristic, which could account for the difference between strong individual hand preference and weak group or species hand preferences.

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Evolution of regional gene expression in the cerebellum of primates

AMY L. BAUERNFEIND[1,2], JOHN J. ELY[3], MARY ANN RAGHANTI[4], WILLIAM D. HOPKINS[5,6], PATRICK R. HOF[7,8], CHET C. SHERWOOD[10,9] and COURTNEY C. BABBITT[11]

[1]Department of Neuroscience, Washington University School of Medicine, [2]Department of Anthropology, Washington University in St. Louis, [3]Alamogordo Primate Facility, Holloman Air Force Base, [4]Department of Anthropology, Kent State University, [5]Neuroscience Institue and Language Research Center, Georgia State University, [6]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center, [7]Fishberg Department of Neuroscience and Friedman Brain Institute, Icahn School of Medicine at Mount Sinai, [8]New York Consortium in Evolutionary Primatology, [9]Department of Anthropology, George Washington University, [10]Center for the Advanced Study of Human Paleobiology, George Washington University, [11]Department of Biology, University of Massachusetts Amherst

The production of language and complex tools are among the behaviors unique to humans. These specializations are dependent upon the cerebellum's ability to execute motor sequences with coordination, precision, and accuracy of timing. The cerebellum can be divided into three regions based on function: flocculus (balance and posture), vermis (direction and force of movements), and lateral cerebellar hemispheres (sequencing of complex motor actions). We performed quantitative gene expression analyses (RNA-Seq) on samples of the flocculus, vermis, and lateral cerebellar hemispheres from adult humans (n=4) and chimpanzees (*Pan troglodytes*, n=5). We hypothesized that the human lateral cerebellar hemispheres would display molecular adaptation relative to other cerebellar regions because of its importance in sequencing complex motor tasks. We identified 13,489 homologous genes that were expressed in the lateral cerebellar hemispheres of both humans and chimpanzees. Of these genes, 6,682 were differentially expressed (FDR ≤ 0.01). Gene enrichment analyses revealed that many of the biological pathways represented (7 of 20 categories) support the transport of ions, the fundamental process underlying neuronal action potentials and maintaining the neuronal membrane potential. Most of the genes involved in ion transport were more expressed in humans, suggesting molecular specialization occurring in the lateral cerebellum within the human lineage. Our study is the first region-specific investigation of gene expression in the primate cerebellum. It aims to uncover novel gene pathways responsible for uniquely human behaviors.

This study was funded by The Leakey Foundation, James S. McDonnell Foundation, and the National Science Foundation.

Biomechanical correlates of premolar root variation in robust and gracile capcuchins

SARAH E. BAUMGARTEN[1], AMANDA L. SMITH[1,2], KRISTIN A. WRIGHT[3], BARTH W. WRIGHT[4], ROBERT S. SCOTT[5], CALLUM F. ROSS[2] and DAVID S. STRAIT[1]

[1]Anthropology, Washington University in St. Louis, [2]Organismal Biology & Anatomy, University of Chicago, [3]Biomedical Science, University of Missouri Kansas City, [4]Anatomy, Kansas City University of Medicine and Biosciences, [5]Anthropology, Rutgers University

Premolar root morphology varies in early hominins and it has been hypothesized that root form in primates is functionally related to diet and feeding mechanics. This project uses finite element analysis to test whether differences in premolar root morphology in two capuchin species, known to differ in diet, are associated with stress differences in the root. Finite element models were constructed from microCT scans of P_2 of one *Sapajus apella* and one *Cebus olivaceus*. The periodontal ligament (PDL) was modeled as a solid volume between the surfaces of the root and alveolus. The crown, root and ligament were assigned the material properties of enamel, dentin and PDL, respectively. The models were constrained along the surface of the alveolus and each subjected to vertical bite force of 300N (estimated to be the maximum premolar bite force of *S. apella*). The root in *S. apella* is longer and mesiodistally thicker than *C. olivaceus*. Thus, the *C. olivaceus* model was further subjected to a reduced bite force scaled to remove the effect of size and ensure that any stress differences between it and the *S. apella* model reflect only differences in shape. Results indicate that the spatial patterning of stresses is different in the roots and crowns of the two species, but shape differences alone do not produce major difference in stress magnitude. However, shape differences are associated with differences in stress magnitude in the PDL, suggesting that variation in root morphology may be the consequence of, or constrained by, PDL mechanics.

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Reassessing the dispersal of the earliest crown clade primates across the Northern Hemisphere during the Paleocene-Eocene thermal maximum (PETM)

K. CHRISTOPHER BEARD

Biodiversity Institute, University of Kansas, Ecology & Evolutionary Biology, University of Kansas

Species of *Teilhardina* have been reported from earliest Eocene strata of Asia, North America and Europe, demonstrating that these tiny primates were able to rapidly colonize most of the Northern Hemisphere during the hyperthermal conditions of the PETM. However, precisely how these early primates dispersed has remained contentious. One hypothesis holds that *Teilhardina* dispersed from Asia to Europe to North America. Alternatively, the discovery of *Teilhardina magnoliana* from Mississippi suggests that *Teilhardina* dispersed across Beringia from Asia to North America before colonizing western Europe. New data regarding the age of *T. magnoliana* comes from the Harrell Core, 10 km away from its type locality. Based on the contact between the Tuscahoma and Bashi formations, *T. magnoliana* can be shown to occur within the main body of the carbon isotope excursion (CIE) associated with the PETM, roughly 3 m above its local onset. *T. magnoliana* occurs below a sequence boundary corresponding to an important drop in eustatic sea-level along the Gulf Coastal Plain. The earliest specimens of *Teilhardina* from the Bighorn Basin in Wyoming occur roughly 9 m above the local onset of the CIE. In western Europe, *T. belgica* has been interpreted to occur within the PETM, but the geological basis for this interpretation is questionable. *T. belgica* comes from just above a sequence boundary corresponding to a drop in eustatic sea-level. If *T. belgica* lies within the PETM, it is reasonable to correlate the sequence boundaries in Mississippi and Belgium, making *T. magnoliana* demonstrably older than *T. belgica*.

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Biological anthropologists as stakeholders in global climate change messaging

MELANIE M. BEASLEY

Anthropology, University of Tennessee, Knoxville

It seems that many people in the general public have missed the message and don't feel that climate change will impact them (i.e., changing sea levels while living in a land-locked state might feel very disconnected). Over the past decades, climate scientists have not been successful in effectively convincing the majority of people that climate change will impact them. It is time for biological anthropologists, as important stake-holders in this messaging, to frame a public dialogue on how global climate change will impact every human. Biological anthropologists are particularly well situated to engage the general public in discourse about the effect of environmental change on all primates and how climate change is relevant to humans. As biological anthropologists, we have the luxury of a longue durée perspective and often take a multi-scale approach to understand human evolutionary history at the family (primatologists), genus (paleoanthropologists), and species (bioarchaeologists, human biologists) level. Each subdiscipline invokes climate change in explanations of observed behavior and evolutionary change by combining direct and indirect data derived from an array of methodologies across varied temporal and spatial scales. This session is an attempt to ventilate our proverbial research silos with a culture of open communication and information flow related to climate studies. As a community, biological anthropologists are primed with the longue durée and a multi-scale approach to engage the general public and to distill scientifically sound, but meaningful, take-home messages about the consequences of global climate change on humans which can be easily understood by everyone.

The taxonomic diagnosis of the StW 578 cranium from Jacovec Cavern, Gauteng (South Africa): integrating inner and outer morphology

AMÉLIE BEAUDET[1,2], KRISTIAN J. CARLSON[3,4], RON J. CLARKE[4], FRIKKIE DE BEER[5], MANUEL DIERICK[6], JASON L. HEATON[4,7,8], TRAVIS R. PICKERING[4,8,9] and DOMINIC STRATFORD[1,4]

[1]School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg, South Africa, [2]Department of Anatomy, University of Pretoria, Pretoria, South Africa, [3]Department of Cell and Neurobiology, University of Southern California, Los Angeles, USA, [4]Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg, South Africa, [5]South African Nuclear Energy Corporation, Pelindaba, South Africa, [6]Department of Physics and Astronomy, Ghent University, Ghent, Belgium, [7]Department of Biology, Birmingham-Southern College, Birmingham, USA, [8]Plio-Pleistocene Palaeontology Section, Department of Vertebrates, Ditsong National Museum of Natural History, Pretoria, South Africa, [9]Department of Anthropology, University of Wisconsin, Madison, USA

The Sterkfontein Caves site is one of the richest early hominid fossil localities in Africa. The fossiliferous deposits within the lower-lying Jacovec Cavern yielded valuable hominid remains, prominent among them is the *Australopithecus* partial cranium StW 578. Due to the fragmentary nature of the braincase, the specimen has not yet been formally assigned to a species. To address this, we employed high-resolution microtomography to explore taxonomically diagnostic features in the StW 578 cranium. As comparative material, we considered a number of Plio-Pleistocene South African hominid cranial remains from Makapansgat (n=3), Sterkfontein (n=5) and Swartkrans (n=4), as well as a representative sample of extant humans (n=6) and common chimpanzees (n=6). Because of their potential to taxonomically differentiate hominid specimens, we quantitatively investigated the inner ear morphology, the cranial vault inner structure and the cranial outer shape by combining various analytical approaches (i.e., landmark-based analyses, automated assessment of cranial vault thickness and of tissue proportions, surface analyses). The thick diploë-dominated cranial vault reported in StW 578, as well the inner ear morphology, closely approximate the condition described in the specimens from Sterkfontein Member 4 attributed to *Australopithecus*. Interestingly, the bone tissue proportions and the external shape of the StW 578 cranial vault are more similar to humans than to chimpanzees. Besides providing the first microtomographic-based database recording variation in inner and outer South African Plio-Pleistocene hominid cranial morphology, our study adds further evidence for discussing the taxonomic diagnosis of this enigmatic specimen and, to a larger extent, the hominin palaeobiodiversity at Sterkfontein.

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Growth patterns of lumbar spinal muscles between ages 2 and 20: cross-sectional study

ELLA BEEN[1,2], SARA SHEFI[1], LEONID KALICHMAN[3], JEANNIE BAILEY[4] and MICHALLE SOUDACK[5,6]

[1]Department of Physical Therapy, Faculty of Health Professions, Ono Academic College, [2]Department of Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University, [3]Physical Therapy Department, Recanati School for Community Health Professions, Faculty of Health Sciences, Ben-Gurion University of the Negev, [4]Orthopaedic Surgery, University of California, [5]Sackler School of Medicine, Tel Aviv University, [6]Department of Diagnostic Imaging, Sheba Medical Center, Tel Hashomer

Spinal muscle cross-sectional area (CSA) is highly associated with spinal pathology. Despite the medium-high prevalence of spinal pathology in children, there is very limited knowledge regarding muscle size and growth pattern in individuals younger than 20 years of age.

The aim of this study is to analyze the growth pattern and symmetry of spinal muscles (erector spinae, multifidus, quadratus lumborum, and psoas) in children 2-20 years of age.

We studied reformatted images from 90 abdominal computed tomographic scans of children aged 2 to 20 years. The CSA of the muscles and of the upper vertebral endplate was measured at spinal levels L3– S1.

The results of this study indicates that spinal muscles exhibited two patterns of growth: the erector spine and multifidus (epaxial muscles) reached their maximal CSA at 16 years of age, before skeletal maturity. The psoas and quadratus lumborum (hypaxial muscles) continued to grow at least until spinal maturity (20 years

of age). Asymmetry of the right and left side CSA was found in psoas and erector spinae, but not in multifidus and quadratus lumborum. At spinal levels L3-L5 muscles' growth exceeded the growth of the vertebral bodies, indicating that the loads and stresses that the muscles exert on the vertebrae are increasing with age. The results of this study may serve as a reference for the assessment of muscles in spinal pathologies in young individuals. Future longitudinal studies are needed for further understanding of muscle development during childhood and adolescent.

Hominoids and associated fauna from Alsótelekes, a new late Miocene locality in Hungary

DAVID R. BEGUN[1] and JAY KELLEY[2,3]

[1]Anthropology, University of Toronto, [2]Institute of Human Origins, School of Human Evolution and Social Change, Arizona State University, [3]Department of Paleobiology, National Museum of Natural History, Smithsonian Institution

Alsótelekes is a small village in north-central Hungary, about six kilometers north of Rudabánya. Mining activity has exposed Neogene sediments including a sequence of late Miocene clays and lignites. The sediments are similar to those of the hominoid bearing R. II locality at Rudabánya. In 2015 we began excavations after surface collecting in previous years. The clay sediments are richer in terrestrial and lacustrine gastropods than R. II and the clay is less calcareous. To date we have only recovered fauna from a single clay layer in the sequence. Extensive listric faulting makes it difficult to trace this layer throughout the exposed section but geological studies are underway to establish a firm stratigraphy of the site. The fauna includes turtle, snake, amphibian, suid, rhino, *Hippotherium* (Hipparion), bovid, cervid, moschid, flying squirrel, beaver and other rodents, insectivores and a hominoid. It also contains crustacean and fish remains, which are absent from Rudabánya. The hominoid fossils include a partial associated upper dentition, two isolated upper central incisors, two phalanges, a talus and a lunate from at least two individuals. All specimens except the incisors are smaller than their homologues at Rudabánya and among the smallest known from Europe. The incisors are broadly similar to those from Rudabánya but with some differences in lingual morphology. One incisor, part of the associated dentition, is larger relative to the postcanine teeth than at Rudabánya. While definitive taxonomic conclusions are premature, the working hypothesis is that the Alsótelekes ape represents a new species of *Rudapithecus*.

Narrower scales of mesowear ordinal methods are more predictive of ecological variables: Implication for paleoecological reconstruction of an early *Homo* site

MIRIAM BELMAKER[1] and HALEY D. O'BRIEN[2]

[1]Department of Anthropology, The University of Tulsa, [2]Department of Anatomy and Cell Biology, Oklahoma State University Center for Health Sciences

The site of 'Ubeidiya (early Pleistocene, Israel) reveals evidence of early *Homo* occupation. Alternative hypotheses describing the site's paleoecology range from woodland to grassland. These disparate interpretations have implications for understanding the role of environment in the dispersal of *Homo* from Africa, and early *Homo* landscape use.

Mesowear, developed in 2000, uses categorical variables to describe the degree of facet development on selenodont ungulate molars, and is thought to reliably predict diet and thus habitat. A preliminary study of 'Ubeidiya cervid mesowear suggests a mixed closed-open environment, similar to today.

Recently, modifications to the original mesowear method have been developed, varying in range of ordinal scaling from 0-to-3 to 0-to-6. If these methods outperform that of the original method, reanalysis of 'Ubeidiya ungulates may alter previous conclusions. However, no study has been conducted to test the equivalency and efficacy of these methods in predicting ecological parameters.

We compared different mesowear metrics (0-to-3, 0-to-4, 0-to-6) across 30 species within Euungulata, evaluating correlations of mesowear with ecological variables (precipitation, percent dietary grass, and habitat categories). Relative similarity was explored using stochastic character mapping within a phylogenetic comparative framework. Correlation values indicate that 0-to-3 and 0-to-4 out preform 0-to-6 ($r > 90\%$ compared to $<80\%$). We applied the 0-4 mesowear method to several 'Ubeidiya ungulates. Results indicate that paleoecology was probably more humid and closed than previously assumed. This suggests that early *Homo* utilized a wide range of environments and that dispersal into Eurasia was not associated with expansion of preferred habitats.

Prehensility in Hominins: anatomical qualifications of "precision grip" in living & fossil primates

CAITLIN BEMIS[1], DANIEL GEBO[1], MITCH IRWIN[1] and KAREN SAMONDS[2]

[1]Anthropology, Northern Illinois University, [2]Biological Sciences, Northern Illinois University

Prehensile activity is the application of forces while grasping an object. In the crudest way, prehensile movements of the hand can be divided into two types based on actor needs of precision or power in their grip postures. To analyze prehensility more specifically, I suggest that movements of the hand can be divided into three groups including power, modified precision, and true precision grips. Modified precision grips are defined as anatomically restricted hand postures mimicking the forceful pinch biomechanics of true precision grips. In this project, I study evolution of the human hand by assessing hand proportions, finger curvature, and fourth metacarpal articulation in comparison of apes (*Pan troglodytes, Gorilla gorilla, Hylobates lar*), other primates (*Papio anubis, Cebus apella*), and several fossil humans (*Ard. ramidus, Aus. afarensis, Aus. sediba, Homo naledi, Homo habilis, Homo neanderthalensis*)in association with evolution of grasping tools using true precision grip. Given a more general hand use of "other" primates, their enhanced dexterity capabilities are informative about the evolution of true precision grip in the human fossil record. To compare all expressed averages in intrinsic and extrinsic hand proportions, included angle of phalangeal curvature, and radius of phalangeal curvature of measured specimens, principal component analysis test is used. Overlap occurring in analysis may suggest that true precision grip is possible in other non-human primates besides humans signifying that tool-use would have been possible before appearance of stone tools. Meaning that true precision grip is not anatomically unique to humans, but only behaviorally.

Northern Illinois University Department of Anthropology

What teeth can tell you: oral health in two Paleo-Indian populations

BOBBIE M. BENAVIDEZ[1,2] and DAVID HUNT[1]

[1]Physical Anthropology, Smithsonian Institution, Washington D.C., [2]Anthropology, California State University Dominguez Hills, Carson CA

This research using individuals from the Indian Knoll site, Kentucky, and Illinois Bluff, Illinois, provides a deeper assessment of life in the Archaic and Late Woodland periods. At Indian Knoll, mounds of discarded shells demonstrate a diet consisting mainly of ground acorns and bivalve mollusks. Moreover, paleobotanical analyses at Illinois Bluff indicate the domestication of plants and rudimentary transition towards agriculture. By examining the dental and alveolar region of the skeleton for oral health at Indian Knoll and Illinois Bluff, evidence of differential diet and food pathways can be used to make inferences about how these peoples differed through time and embodied social differences in everyday life. In this study, one hundred and four individuals were analyzed for evidence of carious lesions and other oral pathologies. Carious lesions develop through a demineralization process of tooth enamel as a result of oral bacteria. Thus, diet is a contributing factor to the formation of caries because of both acidic food sources that erode

enamel and sugars that feed specific species of cariogenic bacteria. The results of this study from Indian Knoll show a statistically significant sex difference in caries prevalence-with females demonstrating a higher frequency of caries than males. Sex-specific material culture is associated with many Indian Knoll burials, alluding to a differential social organization. Illinois Bluff demonstrated an overall higher frequency of caries across the population and only slight differences between sexes. This study identifies that social stratification can be interpreted in both populations through skeletal remains.

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Host-parasite interactions in a small island setting: Determining exposure and susceptibility to bot flies (*Cuterebra baeri*) in wild howler monkeys (*Alouatta palliata*)

KATHRYN M. BENAVIDEZ[1], KATHARINE MILTON[2] and MICHAEL D. WASSERMAN[1]

[1]Anthropology, Indiana University, [2]Department of Environmental Science, Policy, and Management, University of California Berkeley

Howler monkey bot flies (*Cuterebra baeri*) have been proposed as the primary cause of death in wild howler monkeys (*Alouatta palliata*) on Barro Colorado Island (BCI), Panama. Although much variation in bot fly loads across individuals and groups over decades and peak months and years of bot fly prevalence have been correlated with high mortality rates, little is known about the factors that explain this variation. Therefore, we initiated a spatiotemporal study of howler monkey exposure and susceptibility to bot flies based on physiology and environment. We collected fecal samples (n = 84) from 18 howler monkey groups present on BCI. Bot fly warbles were counted on 14 of these groups. Bot fly distribution among groups ranged from one to 12 with an average of approximately five bot flies per group (SD = 3.56). The majority of bot flies were observed on juveniles with an average of five per individual detected, while the lowest loads were observed on adult males with none detected. We propose that variation in bot fly load results from differences in susceptibility of howler monkeys based on immunocompetence and exposure to bot fly larvae. To address this variation, research is currently underway to investigate differences in gut microbiota, endocrine and immune function, and toxin exposure across BCI. By illuminating the synergistic relationships between the environment, host physiology, and parasite abundance, we will improve our understanding of factors that influence the effectiveness of howler monkeys on BCI to limit parasites through physiological or behavioral mechanisms.

Funding for the research was supplemented by the Skomp Feasibility Fellowship from Indiana University and a Sigma Xi GIAR.

Exploring a connection between matriline dominance rank and linear enamel hypoplasia in Cayo Santiago rhesus monkeys

ZEYNEP BENDERLIOGLU[1] and DEBBIE GUATELLI-STEINBERG[2]

[1]Evolution, Ecology, and Organismal Biology, The Ohio State University, [2]Department of Anthropology, The Ohio State University

Linear enamel hypoplasia (LEH) is a developmental defect ranging from minor to major grooves in tooth enamel. Environmental stressors, including lack of food and infectious diseases during critical periods of development, are known to induce LEH in human and non-human primates. Previous research has demonstrated that in the *Macaca mulatta* Cayo Santiago colony, low matriline dominance rank is associated with behavioral and physiological stresses that are adverse to health. Here, we build on our earlier study of LEH and matriline rank by restricting analysis to female offspring and by controlling for age, as both sex and age affect LEH expression in this population. Cayo Santiago records were used to determine offspring matriline rank corresponding to the time period during which lower premolars were forming. A total of 86 females from lower-ranking (LR) and higher-ranking (HR) matrilines constituted our sample. We hypothesized that LR females would have a greater number of LEHs than HR individuals. Results supported our hypothesis. The mean number of defects was higher in individuals belonging to the LR compared to the HR group. There was also a significant negative relationship between age and LEH, mostly likely due to the attrition and abrasion of enamel that wear away shallow enamel defects as monkeys age. Our results suggest that the social environment during critical periods of development may influence the formation of enamel defects in non-human primates.

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The upper dentition of middle Miocene *Oreopithecus*-like catarrhines from Maboko Island, Kenya and its implications for nyanzapithecine taxonomy

BRENDA R. BENEFIT[1], RUTGER JANSMA[2] and MONTE L. MCCROSSIN[1]

[1]Anthropology, New Mexico State University, [2]Anthropology, University of Minnesota

Middle Miocene deposits at Maboko Island preserve the largest sample of nyanzapithecine catarrhines (n=187), most of which were collected during excavations in 1996-1997. We previously reported the discovery of nearly complete mandibles of *Mabokopithecus clarki* and *Nyanzapithecus pickfordi* in this collection. Diagnostic lower dental features that distinguish these taxa include the more caniniform I2 and smaller M3 hypoconulid of *N. pickfordi*. In this study we use the morphology of the lower dentition to infer that of the upper dentition, elucidating a suite of new traits that have important consequences for nyanzapithecine phylogeny.

The caniniform upper I2 with large distal contact facet in premaxilla KNM-MB 11842 corresponds to the shape and occlusion of the *N. pickfordi* lower I2. Its associated I1 differs from a second I1 morph that we now identify as *Mabokopithecus clarki*. As in *N. alesi*, the transition between the I1 lingual cingulum and mesial marginal ridge of *Mabokopithecus clarki* is interrupted by a groove in contrast to the continuous condition of *N. pickfordi*. Upper molars of *Mabokopithecus clarki* and *N. pickfordi* share a combination of features only found in nyanzapithecines and *Oreopithecus* among catarrhines. Significantly, maxillary molars of *N. pickfordi* correspond with the morphology of lower molars in the mandible by being buccolingually narrower relative to length and limited development of the buccal ectoflexus. *Mabokopithecus clarki* and *N. alesi* share upper molars with a strong ectoflexus that are relatively broader than *N. pickfordi*. Generic attributions of other nyanzapithecine species are clarified by the new information from Maboko.

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Testing the Challenge Hypothesis in male capuchin monkeys: hormonal, physical, and behavioral responses to novel females

MARCELA E. BENITEZ[1,2], MEG SOSNOWSKI[1,2], OLIVIA TOMEO[1,2] and SARAH BROSNAN[1,2,3]

[1]Psychology, Georgia State University, [2]Language Research Center, Georgia State University, [3]Neuroscience Institute, Georgia State University

The Challenge Hypothesis, originally formulated to explain fluctuation in androgen levels in seasonally breeding birds, predicts that males should upregulate androgen levels in anticipation of reproductive competition. For over a decade, primatologist have used this framework to examine the relationship between male reproductive behavior and testosterone levels. However, one of the difficulties of studying the challenge hypothesis in primates is that it is often difficult to distinguish between testosterone changes due to increased competition, as the hypothesis predicts, or simply as a byproduct of increased sexual activity. Here, we examined the effects of the introduction of novel females on the physiology and behavior of 7 socially-housed male capuchin (*Cebus [Sapajus] apella*) monkeys (n=270 fecal samples). We found that males exhibited a drastic increase in testosterone levels (LMM; β=1.88, t= 3.78, p<0.001) within weeks of being introduced to new females. Furthermore, both aggressive behavior (LMM; β=1.66, t= 2.71, p=0.02) and body mass (LMM; β=0.39, t= 2.32, p=0.04) increased with changes in testosterone

levels. Our data suggest that males rapidly upregulate testosterone levels, and in turn increase overall competitive ability, in responses to anticipated challenges over mating opportunities.

This research was funded by the Georgia State University Brains & Behavior Seed Grant.

Linking the past to the present, anthropological genetic approach to African and Indigenous American interaction in the Caribbean

JADA BENN TORRES[1] and HARCOURT FULLER[2]

[1]Anthropology, Vanderbilt University, [2]History, Georgia State University

The emergence of Afro-indigenous populations in the Caribbean is informed by a limited number of ethnohistoric sources primarily from European chroniclers. While such sources provide some insight into the interaction between Indigenous Caribbean and African peoples, arguably, there are significant gaps in knowledge regarding the frequency and distribution of such encounters.

As part of a preliminary study into this issue, previously published and novel genetic data from uniparental markers were used to examine the extent of Indigenous Caribbean and African interaction within two islands in the Greater Antilles. A total of 66 people from two rural Jamaican communities and 30 self-identified Afro-Puerto Ricans from Bélgica, Loíza, Mayagüez, Piñones, and Ponce were sampled.

A series of descriptive analyses, including direct counting of haplotype frequencies and estimating standard diversity indices, indicates that there are variable levels of genetic diversity within these communities. Additionally, there are slight differences in the number and type of mitochondrial haplogroups represented in the sample, indicating varied ancestry for each community. When combining the samples, 90% of the individuals belonged to a sub-Saharan mitochondrial haplogroup and 71% belonged to a sub-Saharan Y chromosome haplogroup. The remaining mitochondrial and Y chromosome haplogroups represented Eurasian (2%, 27%) and indigenous American (7%, 2%) haplogroups respectively.

This preliminary study supports the idea that African and Indigenous Caribbean peoples interacted more in some regions than in other regions. Future studies include increasing sample size and geographic distribution, autosomal admixture analysis, and dating admixture events.

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Use of back-scattered scanning electron microscopy to quantify bone tissue characteristics in mid-thoracic human ribs

AMY C. BERESHEIM[1], SUSAN K. PFEIFFER[1,2], MARC D. GRYNPAS[3,4] and AMANDA ALBLAS[5]

[1]Department of Anthropology, University of Toronto, [2]Department of Archaeology, University of Cape Town, [3]Department of Laboratory Medicine and Pathobiology and Institute for Biomaterials and Biomedical Engineering, University of Toronto, [4]Lunenfeld-Tanenbaum Research Institute, Mount Sinai Hospital, [5]Division of Anatomy and Histology, Department of Biomedical Sciences, Stellenbosch University

Introduction: Back-scattered scanning electron microscopy (BSE-SEM) is an underutilized technique in biological anthropology. It allows analysis of both the cortical and trabecular bone compartments through high-resolution images of large cross-sections. Machine availability, low imaging costs, and automated data collection permits the study of bone quality.

Materials and methods: Using BSE-SEM imaging, osteocyte lacunar density (Ot.Lc.Dn), cortical porosity (Ct.Po), and bone mineralization density (WMGL) were quantified in mid-thoracic ribs from the Kirsten Skeletal Collection. Individuals (n_{female}=75, n_{male}=68, mean age=46.3 years) were predominantly from the South African Coloured (SAC) population group ($n_{Coloured}$=103, 72%), as classified under the apartheid government. SAC males on the Western Cape were particularly vulnerable to malnutrition and substance abuse during the apartheid era, the period in which these individuals lived and died [1968-1998 AD]. Age-related changes in histomorphometric parameters and sex differences were examined using correlation analysis and (non-)linear regression.

Results: Young adult men have significantly less mineralized bone and fewer osteocyte lacunae in both the cortical and trabecular bone compartments. Depending on the parameter, men do not supersede women in terms of bone quality until either after menopause or during senility. Only women demonstrate a positive relationship between Ct.Po and age.

Discussion and Conclusion: Systemic disenfranchisement of minority groups affected bone health in South Africa, and may continue to do so today. Indicators of poor bone quality are evident in SAC males across the entire adult lifespan, indicating that osteoporosis and fracture risk are not just of concern to the aging, white female population.

Osteology of foot binding in a late Ming Dynasty cemetery in Shaanxi Province, China

ELIZABETH S. BERGER[1], LIPING YANG[2] and WEILIN WANG[3]

[1]Lieberthal-Rogel Center for Chinese Studies, University of Michigan, [2]Shaanxi Institute of Archaeology, [3]Shaanxi History Museum

Foot binding persisted as a widespread practice in China for roughly a thousand years, and its specific form varied across time and space. Furthermore, foot binding was both a form of physical violence and a manifestation of structural violence against women, and by characterizing its changes through time and space, we can better characterize the nature of this violence. This paper presents an osteological analysis of the foot bones of eight female individuals from a late Ming Dynasty (approx. 1610-1644) cemetery in Shaanxi Province. Not all the women appear to have had bound feet. The metatarsal bones and phalanges of the women with bound feet are clearly modified, with smaller articular lengths and midshaft heights than those of women with unbound feet. The dimensions of articular surfaces of the tarsal bones (e.g. calcaneus load arm and talar trochlea) were also distinctive in the modified feet. However, the overall dimensions of the tarsal bones (e.g. lengths of tali and calcanei) were not affected, in contrast to the findings of late-twentieth-century clinical studies of bound feet, which identified profound changes to the tarsal bones in women with bound feet. Therefore, foot binding cannot be analyzed as a unitary phenomenon. Rather, the form of foot binding, which was used to express Chinese (Han) identity, regulate sexual and marriage relations, and express aesthetic preferences, depended on the sociocultural and historical conditions of each region, period, and individual woman. Osteological analysis is a critical source of data for this analysis.

A New Naming Scheme for the Dinaledi Chamber System and Associated Antechambers and Passages of the Rising Star Cave System, South Africa

LEE R. BERGER[1], MARINA C. ELLIOTT[1], BECCA PEIXOTTO[1,2], HANNAH MORRIS[1,3], ELEN M. FEUERRIEGEL[1,4], STEVEN J. TUCKER[1], ASHLEY KRUGER[1], RICK HUNTER[1], DIRK VAN ROOYAN[1], MAROPENG RAMALEPA[1], MATHABELA TSIKOANE[1], ERIC ROBERTS[1,5], CARL SPANDLER[5], PAUL DIRKS[1,5] and JOHN HAWKS[1,6]

[1]Evolutionary Studies Institute, University of the Witwatersrand, [2]Department of Anthropology, American University, [3]Forestry and Natural Resources, University of Georgia, [4]Department of Anthropology, University of Washington, [5]Department of Geoscience, James Cook University, [6]Department of Anthropology, University of Wisconsin-Madison

Further geological investigations and three-dimensional mapping of the cave system associated with the hominin-bearing Dinaledi Chamber have created a greater understanding of the area's complex nature and its origin history. In particular, each chamber, antechamber, and passage associated with the Dinaledi Chamber system appears to have its own unique formation history, associated with, but distinct from, other parts of the system. This fact has required each cave section to be identified individually to ensure an appropriate understanding of the spatial complexity within the network. Here, we present a more comprehensive map of the passages and chambers associated with the Dinaledi Chamber, and a new naming scheme designed to improve the understanding of the system's overall arrangement. The new naming system keeps the original Dinaledi Chamber name for the original excavation area, but now recognizes two other significant spaces – the Hill Antechamber and the Chaos Chamber. Several new skeletal bearing areas in remote passages that include hominin remains are also identified.

We gratefully acknowledge support from the National Geographic Society, the Lyda Hill Foundation, the South African National Research Foundation and the Gauteng Provincial Government for this research.

On the Mississippian Border: Heterogeneous vulnerability to risk at Forbush Creek, North Carolina

STEPH BERGER and DALE HUTCHINSON

Anthropology, University of North Carolina

From approximately AD 700 -1600, the Mississippian culture spread across the American Southeast and profoundly impacted indigenous lifeways throughout the region. Although Mississippian influence often led to the adoption of shared cultural innovations, archaeological evidence highlights the variable experiences within the Mississippian cultural sphere and along the Mississippian border.

Occupied from AD 800-1200, the Forbush Creek settlement in the Piedmont Region in North Carolina provides a unique context to study interactions between indigenous groups and encroaching Mississippian influence. The osteological analysis suggests that Forbush Creek inhabitants experienced considerable violence as a result of their fraught position on the landscape. 12% (n=6/51) of the assemblage sustained violence-related injuries (VRI). Nutrient deficiencies affected 33% (n=17/51) of the assemblage and may have resulted from resource instability and subsistence constraints imposed by the border environment. While intergroup conflict and raiding dominated other Mississippian borders, the violence at Forbush Creek is characteristic of intragroup conflict and inequality. Individuals buried in secondary bundles (47%, n=24) experienced higher frequencies of VRI (F=0.087) and nutrient deficiencies (F=0.035) than individuals buried in primary internments. VRI patterning also suggests that most injuries (67%, n=6/9) resulted from intragroup conflict, such as domestic violence or conflict resolution. The osteological analysis demonstrates that vulnerability to direct and indirect violence was unequally distributed at Forbush Creek. Instability and scarcity may have led to competition within the community, and marginal subgroups, represented by the secondary bundle burials, experienced the stressors of the Mississippian border more acutely.

Convergent selection on growth- and cardiac-related pathways in African and Asian rainforest hunter-gatherers

CHRISTINA M. BERGEY[1,2], MARIE LOPEZ[3], GENELLE F. HARRISON[4], ETIENNE PATIN[3], JACOB COHEN[2], LLUIS QUINTANA-MURCI[3], LUIS B. BARREIRO[4] and GEORGE PERRY[1,2]

[1]Department of Anthropology, Pennsylvania State University, [2]Department of Biology, Pennsylvania State University, [3]Human Evolutionary Genetics, Institut Pasteur, [4]Centre de Recherche CHU Sainte-Justine, Université de Montréal

Most well-characterized examples of parallel genetic change underlying convergent human adaptation to similar ecological challenges involve single loci, for example convergent lactase persistence in European and African populations. It is less clear how evolution may act convergently on polygenic traits such as height. The evolution of the pygmy phenotype (small adult body size) provides an excellent model to study the adaptive nature of a convergent polygenic phenotype. In response to the ecological challenges of tropical rainforest environments, this phenotype evolved convergently in African and Asian hunter-gatherers, but the degree to which this convergence reflects parallel versus population-specific genetic changes is unknown. We analyzed the protein-coding portions (exomes) of the genomes of two pairs of populations: Batwa rainforest hunter-gatherers and neighboring Bakiga agriculturalists from Uganda, and Andamanese rainforest hunter-gatherers and Brahmin agriculturalists from India. Based on our initial analyses, we found population-specific signatures of strong positive selection on multiple genes involved in growth processes as well as convergent polygenic positive selection across the set of genes with growth factor binding functions (GO:0019838; Edgington's combined p=0.00247). We detected no such evidence of selection in genes involved in growth processes in the agriculturalist populations. Furthermore, we found signals of convergent polygenic positive selection in the African and Asian rainforest hunter-gatherer populations on genes related to cardiac development. As growth hormone plays an essential role in heart development and maintenance, the growth hormone sub-responsiveness that may partly underlie the pygmy phenotype may have led to compensatory changes in cardiac pathways.

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How the short-term costs and benefits of play on immature survival until reproduction could shape species- and sex-differences in play rates

ANDREAS BERGHAENEL

Anthropology, University of New Mexico

Play is the hallmark of childhood across primates including humans, whereas it is less frequent and often completely absent in other species. Play rates can also differ within species due to sex differences, and such sex differences are commonly referred to different adult sex roles since play seems to partially reflect adult behaviour. Alternatively, it was argued that play may primarily benefit the individual in the short-term by increasing immature survival until reproduction via enhanced motor and, thereby, flight skills. However, the question of how such short-term benefits may relate to species and sex differences in play has been largely neglected so far. I will provide and discuss a simple life history-based model which could explain the observed differences in play rates from the trade-off between such short-term benefits on immature survival and the observed costs on immature growth. Based on a simple equation I will theoretically show that the optimal play rate of an individual increases with an increasing effect of play on survival and an increasing age at maturation. This pattern could explain both the distribution of play across species as well as sex differences in play. Hence the trade-off between the short-term benefits on immature survival and the observed costs on immature growth may provide a new perspective on the evolution of play rates both within and between species.

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Human cranial diversity seen under a kriging-based model: new proposal to test evolutionary scenarios

DANILO V. BERNARDO[1], TATIANA F DE. ALMEIDA[2,3], ANA CLÁUDIA A. BORELLA[1], TAMIRES C. CAMPOS[1] and WALTER A. NEVES[4]

[1]Laboratório de Estudos em Antropologia Biológica, Bioarqueologia e Evolução Humana, Instituto de Ciências Humanas e da Informação, Universidade Federal do Rio Grande, [2]Laboratório de Estudos de Genes do Desenvolvimento, Instituto de Biociências, Universidade de São Paulo, [3]Diagnósticos Laboratoriais Especializados, [4]Laboratório de Estudos Evolutivos e Ecológicos Humanos, Instituto de Biociências, Universidade de São Paulo

In the last years, several works investigated and discussed the human cranial morphology structure and variation by means of different approaches, using combined sets of statistical and morphometric techniques, and have demonstrated that most of variation observed can be interpreted as evolutionary consequence of successive bottleneck events, suggesting that the stochastic forces, as genetic drift, performed the major role in human cranial morphological diversification process.

Here we used a large craniometric dataset, composed by 9,163 specimens from 159 autochthones populations of worldwide dispersion, to investigate under a kriging-model which geographic areas show high levels of cranial variation. Each skull of the dataset was represented by 24 measurements taken in accordance with the Howell's protocol and both male and female specimens were used to perform analysis after the correction of size. To build our model, we estimated the coefficient of variation of all populations analyzed, associating them with their respective geographic coordinates. This data was submitted to a kriging algorithm, that resulted in a map showing that in a global plane we can consider two geographic areas as peaks of human cranial variation: Africa and Asia. Besides of this our results shows that in a microregional sense high levels of morphological variation are preferentially associated with regions of climatic extremes, suggesting that others evolutionary forces, as Natural Selection, rather than genetic drift alone can be considered as responsible for the global structuring of human cranial diversity.

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Acknowledging worldviews: A proactive strategy for engagement with science

CONSTANCE M. BERTKA[1], BRIANA POBINER[2] and PAUL BEARDSLEY[3]

[1]Science Education, Science and Society Resources LLC, Potomac MD, [2]Department of Anthropology, National Museum of Natural History, Smithsonian Institution, [3]Department of Biological Sciences, Cal Poly Pomona

The majority of Americans (79%) hold favorable views of science, believing that science produces more benefits than harm for society, though 50% believe we depend too much on science and not enough on faith. This is a reminder that while science may be highly valued, it is not necessarily the most important or only source of knowledge for many people. We approach the world with presuppositions about reality and knowledge that are reflective of our worldview. Science communicators face a challenging task when the science they are asking a person to engage with is viewed as threatening to a particular worldview. This is often the case for the topic of evolution where religious or cultural objections can impact both students' willingness to explore a scientific understanding of evolutionary theory and teachers' willingness to provide sound instruction on the topic. We developed and field tested a *Cultural and Religious Sensitivity Teaching Strategies Resource (CRS)* for high school AP biology classrooms that addresses this tension using exercises that acknowledge potential religious and cultural controversies, encourage respect for personal worldviews, and support an understanding of the nature of science. We will present the results of focus groups with students of three teachers who used these exercises in their classrooms before teaching evolution using human examples. We conclude that worldview acknowledgement is a promising pedagogical approach for encouraging engagement with a scientific understanding of evolution in the classroom and by extension holds promise for engaging a wider public on culturally challenging science topics.

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Cementochronology: too precise to be true or too precise to be accurate?

BENOIT BERTRAND[1], EUGENIA CUNHA[2] and VALERY HÉDOUIN[1]

[1]Forensic Taphonomy Unit, University of Lille, France, [2]Laboratory of Forensic Anthropology, Department of Life Sciences, University of Coimbra, Portugal

Cementochronology based on annual deposition of acellular cementum is acknowledged for its superior performance for estimating age at death but is also criticised for its suspicious effectiveness. This contrasting picture is mainly due to a lack of standardization that leads to inconsistent quantitative assessment of its efficiency and to the impact of taphonomical processes that remains unclear. In order to determine the boundaries of the cementum ageing technique, we applied a certified protocol on a sample of 200 healthy canines from individuals of known age, sex and postmortem interval from anthropological and anatomical collections. We scored readability and preservation of cementum tissue and measured the agreement between cementum estimates, i.e. the precision, and assessed the quality of the accordance between chronological age and estimates, i.e. the accuracy. To investigate the applicability of this method on ancient material, 200 additional canines extracted from archaeological assemblages dated between the 12th century and 18th century were included.Accuracy and precision were analysed for each age group in considering postmortem intervals and taphonomical conditions. A strong global correlation was found between chronological age and estimated age [r= 0.927; p=0.000] but results revealed an association between readability of incremental lines and chronological age [p<0.05] and a notable difference in both precision and accuracy between individuals under and over 50 years.This presentation aims, on a large standardized sample, to discuss cementochronology's potential and limitations, and to propose a prediction model to reduce differences between estimated age and chronological age.

Effects of tourism on the behavior of wild, habituated groups of *Macaca nigra*

DOMINIQUE A. BERTRAND[1], CAROL M. BERMAN[1,2], SUSAN W. MARGULIS[3], AGIL MUHAMMAD[4], UNI SUTIAH[4] and ENGELHARDT ANTJE[5,6]

[1]Department of Anthropology, University at Buffalo, [2]Evolution, Ecology, & Behavior Program, University at Buffalo, [3]Departments of Animal Behavior and Biology, Canisius College, [4]Faculty of Veterinary Medicine, Bogor Agricultural University, [5]School of Natural Sciences and Psychology, Liverpool John Moores University, [6]Primate Sexual Selection, German Primate Center (Göettingen, Germany)

There is an assumption that apparent tolerance of tourists at long-running primate tourism sites indicates habituation, and that as a result, primates no longer experience negative consequences of prolonged exposure to visitors. We re-evaluated effects of tourist presence on behavior in three groups of critically endangered, wild crested macaques (*Macaca nigra*) exposed to different intensities of tourism in Tangkoko Nature Reserve, Sulawesi, Indonesia. Group R2 has been exposed to research + intensive tourism for almost 3 decades, R1 to research + less intensive tourism (1 decade), and PB1 to research only. Almost 800 hours of data were collected from thirty-three adults via focal animal, all occurrence, and 1/0 sampling. All data were analyzed with General Linear Mixed Models. When we examined focal sessions with tourists absent, we found that all groups vocalized(Z=-9.96,p<.0001), affiliated(Z=2.87,p=.004), exhibited sexual behaviors (Z=4.16,p<.0001), and displayed self-directed behaviors more(Z=-15.37,p<.001) in months when the number of tourists in the reserve were lower. When comparing tourist groups when tourists were present vs. absent, the more intensely visited R2 males exhibited more self-directed behavior than R1 males(Z=2.07,p=.037), males and females in both groups aggressed more(Z=2.61,p=.009 & Z=3.44,p=.0005), and females were less affiliative(Z=-2.42,p=.015). Also, females aggressed less, regardless of tourist presence, when more guides are present(Z=-2.74,p=.006). Results indicate that primate groups exposed to tourism even for decades may not fully habituate to tourists. However, guides may act as buffers to aggression. Increased aggression paired with decreased affiliative behavior are potentially

disruptive to group cohesion. We suggest adjustments to tourism protocols.

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Primate Sweat Gland Evolution

ANDREW W. BEST[1] and JASON M. KAMILAR[1,2]

[1]Anthropology, University of Massachusetts Amherst, [2]Graduate Program in Organismic and Evolutionary Biology, University of Massachusetts Amherst

Eccrine sweat glands on the body surface of some primates enable thermoregulatory sweating, a capability that is highly derived in humans. The origins and selective pressures driving the evolution of human eccrine sweating are unresolved though current hypotheses include a shift to more open, dry environments and increased locomotor activity. We used a comparative approach examining 15 eccrine gland traits across 35 primate species to investigate the evolution of thermoregulatory sweating. For each trait we measured phylogenetic signal, tested three evolutionary models to explain trait variation, and used phylogenetic models to examine how traits varied in response to climate variables. Gland distribution measures displayed very strong phylogenetic signal while histochemical measures showed weak phylogenetic signal and fit best with an Ornstein-Uhlenbeck model, suggesting selection on these traits. Eccrine gland glycogen content was positively associated with temperature and negatively associated with precipitation, while gland capillarization was positively associated with temperature and negatively associated with precipitation. Glycogen is a primary energy substrate driving eccrine gland metabolism. Increased capillarization allows for increased water, oxygen, glucose and electrolyte delivery. Our results provide evidence for an adaptive function for increased sweating capacity in primate species with body surface eccrine glands living in hotter, drier climates. We suggest that increased glycogen content and capillarization was part of a suite of characteristics associated with the evolution of increased thermoregulatory sweating capacity in hominins. Future research will focus on the effect of climate on sweat gland counts and function in modern humans.

The History of Health on a Global Scale: Clark Larsen's Contributions to Our Understanding of Health in the Past

TRACY K. BETSINGER[1] and JAIME M. ULLINGER[2]

[1]Anthropology, SUNY Oneonta, [2]Sociology, Criminal Justice and Anthropology, Quinnipiac University

Over the past 40+ years, Clark Larsen has been engaged in examining health from a bioarchaeological perspective. His areas of research include addressing large-scale issues, such as the impact of agriculture and the effects of contact and conquest. He has examined these types of questions on a local, regional, national, and global scale, often collaborating with other professionals. He has published on skeletal samples from Brazil, Peru, Albania, Greece, Italy, Germany, Turkey, Japan, and the United States. In his attempt to address broad and narrow research questions about patterns of health, diet, activity, disease, and trauma, he has utilized a wide variety of bioarchaeological research methods, including analysis of stress markers, disease, oral health, tooth size, wear, and modification, traumatic injuries, postcranial morphology, and isotopic analysis. In the 1990s, Larsen collaborated with other researchers to explore patterns of health in the Western Hemisphere. In the following decade, this project was expanded to assess human health over the millennia on a global scale. This poster will examine how Larsen's research has contributed to our understanding of health in the past, by highlighting the patterns and trends he has helped to identify through his varied research projects. For example, his work on the adoption of agriculture by indigenous North American populations revealed the degree to which these groups experienced deterioration of health, decrease in nutrition, and increased workload. We will explore his work and its impact on the biocultural study of health and disease on a global scale.

Species and population differences in calling pattern of galagos in contrasting habitats

CAROLINE BETTRIDGE, GRACE ELLISON, SIMON KENWORTHY and SELVINO DE KORT

Biology & Conservation Ecology, Manchester Metropolitan University

Vocal communication is an important component of the behavioral repertoire of nocturnal primates, exemplified by the wide and varied vocal repertoires and frequent calling in many species. However, there is little empirical data exists on the behavioral contexts and calling pattern of most nocturnal primate species. We used passive acoustic monitoring devices (PAMs) to investigate the vocalization patterns of two galago species: *Galago senegalensis* and *Otolemur garnettii*. We describe differences in their calling patterns between savannah woodland and Afro-montane forest; and in areas where the species occur in sympatry versus allopatric populations. We found striking intraspecific differences in calling patterns between populations, and within-population differences in structural parameters, as well interspecific differences in calling patterns. We discuss the potential underlying causes of these differences, and highlight the potential of PAM to offer new insights into the behavior of elusive taxa, particularly in challenging habitats.

Trashing the field: field site and species bias in primatology

MICHELLE BEZANSON[1] and ALLISON MCNAMARA[2]

[1]Anthropology, Santa Clara University, [2]Anthropology, University of Texas, Austin

We are in the midst of a narrow opportunity to make a conservation difference about the future of nonhuman primates. According to Estrada et al. (2017), approximately 60% of primates are threatened, and globally 75% of primate species are experiencing some level of population decline. To assess where primatologists work and the most common species examined, we reviewed all articles in the 2011-2015 issues of the American Journal of Primatology, International Journal of Primatology, Primates, American Journal of Physical Anthropology, Journal of Human Evolution, Nature, Science, and PNAS (9,041 articles). We identified and mapped (ArcGIS) 876 field visits to 349 field sites. Kibale National Park (NP) was the most frequently visited site with 40 field visits, followed by Santa Rosa NP (17), Mahale NP (16), Cayo Santiago (14), Awash NP (14), and Gombe Stream NP (14). Mainland Africa was visited in 33.57% of the studies, followed by the Neotropics (30.26%), Asia (25.89%), and Madagascar (10.28%). The majority of primate field research occurred in national parks and reserves. The most frequently studied primate genera were *Pan*, *Macaca*, *Alouatta*, *Cebus*, *Ateles*, and *Papio*. *Pan troglodytes* dominated the primate literature and appeared in 118 field studies. Relatively few studies identified direct or indirect conservation outcomes in their work. We need to immediately influence our discipline to incorporate and publish these outcomes. In addition, we need to better assess where we work and the potential impacts of our work.

Estrada, A., et al. 2017. *Science advances. 3*(1), e1600946

Geometric Morphometric Applications to Sexual Dimorphism Using the First and Second Ribs

HENNA D. BHRAMDAT

Anthropology, Florida Atlantic University

There are few methodologies for exploring aspects of sexual dimorphism in the thorax. This presentation explores sexual dimorphism of the ribs by examining degrees of variation in the right first and second ribs, through the use of geometric morphometrics. A test for this sexual dimorphism was performed on first and second ribs from the William M. Bass collection (n= 140). Both landmark and semilandmark coordinate points were used to identify multiple visual approaches for capturing variability in the

rib's shape. Analysis of predetermined landmark coordinate points revealed no strong differences between the morphological characteristics of males and females on the first rib (p = 0.7763) or the second rib (p = 0.9717). However, analysis of the semilandmark coordinate points revealed statistically significant differences between the male and female first rib (p = 0.0819) and the second rib (p = 0.00003061). This research suggests that there are observable morphological variations in male and female first and second ribs. The methodology described in this presentation highlights an application of semilandmark coordinate points to ribs which may be useful for sex estimations in forensic and bioarchaeological studies.

New regression equations for adult living stature estimation in a South African population group using measurements from MRI scanograms

MUBARAK A. BIDMOS[1,2], DESIREE BRITS[2] and PAUL MANGER[2]

[1]Basic Medical Sciences, Qatar University, Doha, [2]Faculty of Health Sciences, University of the Witwatersrand, Johannesburg

One of the most important steps in the identification of a person from skeletal remains is the estimation of stature. Measurements from various bones of the skeleton have been used in the formulation of regression equations for stature estimation. However, long bones of the upper and lower extremities are widely used for this purpose because of the high correlation that exist between these bones and stature. In 1987, Lundy and Feldesman presented regression equations for stature estimation for the black South African population group based on measurements of bones from the Raymond Dart Collection of Human Skeletons. The validity of these equations has been questioned by local anthropologists. In the current study, living stature measurement (LSM) and MRI scanograms of 58 volunteers (28 males and 30 females) who are members of modern black South African population group were obtained. Physiological length of the femur (FEML) and condylomalleolar length of the tibia (CMLT) were measured on each scanogram and substituted into appropriate equations of Lundy and Feldesman (1987) to obtain estimate of living stature (ELS). A comparison was made between LSM and ELS using paired t-test which showed statistically significant difference, an indication of non-validity of Lundy and Feldesman's (1987) equations. Both FEML and CMLT presented with significantly high positive correlation with LSM (0.88-0.92). New regression equations were formulated separately for males and females and the resulting standard error of estimate (2.14 – 2.58cm) compared well with those presented for other studies utilizing long limb bones.

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Hippopotamid ecology in the Turkana Basin: isotopic variation across the Pleistocene

MARYSE D. BIERNAT[1], DAVID R. BRAUN[2] and DAVID B. PATTERSON[3]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Center for the Advanced Study of Human Paleobiology, The George Washington University, [3]Department of Biology, University of North Georgia

Today, the family Hippopotamidae is represented by two genera, *Hippopotamus* and *Hexaprotodon*. Modern representatives of these genera differ significantly from one another in terms of size, ecology, and geographical distribution. While differences in size span back as far as the Miocene, throughout their fossil record in Africa, it is unclear whether these taxa differed ecologically. In this study, we use a large compilation of published and unpublished carbon and oxygen isotope values (n > 90) to investigate the ecology of *Hippopotamus* and *Hexaprotodon* at East Turkana in northern Kenya between 2.0 and 1.4 Ma to provide insights into ecosystem dynamics during this important period in hominin evolution. Our analyses of fossil hippopotamids indicates significant spatial differences in carbon isotope signature, but relatively little change through time. We also find no significant difference in carbon isotope signature between the *Hippopotamus* and *Hexaprotodon* during this period. Hippopotamid oxygen isotopic data are particularly useful for insights into basin hydrology in the region. We find no significant difference in hippopotamid oxygen isotope signature across temporal or geographic boundaries. We also find no significant differences between the *Hippopotamus* and *Hexaprotodon* lineages during this period. Our findings suggest that 1) hippopotamid diet and ecology do not track well-documented landscape alterations during this period in East Turkana and 2) the *Hippopotamus* and *Hexaprotodon* lineages had overlapping isotopic niches during this period. The latter finding should be further addressed with more highly resolved dietary analyses (e.g., seasonality, $\Delta^{17}O$).

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Genomic Adaptation to High Altitude Among Peruvian Quechua

ABIGAIL W. BIGHAM[1], MELISA KIYAMU[2], GIANPIETRO ELIAS[4], JENNA L. ISHERWOOD[1], FRANK S. LEE[3], MARIA RIVERA-CHIRA[2], FABIOLA LEON-VELARDE[2] and TOM D. BRUTSAERT[4]

[1]Anthropology, The University of Michigan, [2]Departamento de Ciencias Biológicas y Fisiológicas, Universidad Peruana Cayetano Heredia, [3]Department of Pathology and Laboratory Medicine, University of Pennsylvania, [4]Department of Exercise Science, Syracuse University

Over the course of some 11,000 years, humans have colonized the Andean Altiplano (Plateau), which boasts an average height of 12,000 feet (3,700 m). At this altitude, oxygen concentration is only 65% of that at sea level, yet Andeans have flourished under these harsh environmental conditions. To refine our understanding of the Andean pattern of high-altitude adaptation, we recruited four study groups with varying developmental exposures to high altitude: 1) Quechua born and raised at high altitude, 2) Quechua born and raised at low altitude, 3) Quechua low-altitude down migrants, and 4) Low-altitude participants of European ancestry. Pulmonary and hematological phenotype data were collected at the time of enrollment. SNP genotype data were generated using the Affymetrix Biobanking Array. From these data, we identified several selection nominated candidate gene regions for high-altitude adaptation including genes that are part of the hypoxia inducible transcription factor (HIF) pathway as well as other genomic regions. We then tested polymorphisms in a single high-altitude adaptive gene, *EGLN1*, for associations with VO_2Max and hemoglobin concentration. We identified SNP variation in *EGLN1* that affects the capacity for oxygen transport and/or oxygen uptake during aerobic exercise. Furthermore, contrary to findings among Tibetans, we did not identify *EGLN1* SNPs contributing to hemoglobin concentration in Andeans. Together, our results provide critical insights into the genetic mechanisms underlying the Andean pattern of adaptation to high altitude and help refine the Tibetan and Andean contrast.

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Spatial Parameters Influence the Distribution of Orangutan (*Pongo pygmaeus wurmbii*) Dispersed Seeds

ANDREA BLACKBURN[1], YAXIONG MA[2], SUCHI GOPAL[2], . RIYANDI[3] and CHERYL D. KNOTT[1]

[1]Anthropology, Boston University, [2]Earth and Environment, Boston Univeristy, [3]Biology, University of Tanjungpura

Animal-mediated seed dispersal is important for promoting forest regeneration and sustainability. Animal movement influences the distribution of seeds across the environment, resulting in spatially aggregated seed dispersal patterns. Animal seed dispersal patterns likely play an important role in the spatial structuring of tree populations: where a seed disperser moves

influences the seed distribution. Environmental parameters that shape a disperser's movement also influence the spatial distribution pattern of their seed dispersal. Orangutans are highly frugivorous and have been shown to disperse intact viable seeds. GPS locations were recorded for all orangutan defecations (n=1721) from 2014 to 2016 at the Cabang Panti Research Station in Gunung Palung National Park (GPNP), Indonesia. Our pilot research at GPNP measured seeds in fecal samples (n=98 fecal samples) and demonstrated that orangutan fecal samples do have intact seeds in more than 95% of their feces. A kernel density map was made using the defecation data to calculate the spatial density distribution of the defecations. A geographically weighted regression model (GWR) analyzed how well spatial parameters (altitude, slope, distance to river, and normalized difference vegetation index) predict the spatial density distribution of orangutan seed dispersal. All parameters in the GWR were statistically significant (R^2=0.80, p<0.001) and showed low values for collinearity. The results show that orangutan seed dispersal is aggregated in space and the seed dispersal pattern is significantly shaped by environmental variables. This study provides us a better understanding of how the environment plays a role in determining animal behavior which influences the seed spatial distribution.

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To arouse or not to arouse: physiological responses from active thermogenesis versus thermoconforming in hibernating dwarf lemurs

MARINA B. BLANCO[1], PETER H. KLOPFER[2] and ANDREW D. KRYSTAL[3]

[1]Duke Lemur Center, Durham, [2]Biology Department, Duke University, [3]Department of Health Psychology, University of California San Francisco

Madagascar's dwarf lemurs (genus *Cheirogaleus*) use hibernation obligatorily as a metabolic strategy to save energy. Under cold conditions, dwarf lemurs undergo torpor bouts interspersed with periods of thermogenically-induced arousals, during which they become euthermic. However, under hot conditions, dwarf lemurs can achieve euthermy passively. These transitory bouts of euthermy during torpor enable critical physiological processes that require high body temperature. To better understand the links between hibernation, temperature, and physiology, we compare dwarf lemurs hibernating under different conditions: (a) dry-forest dwarf lemurs at Kirindy "thermoconforming" in poorly-insulated tree holes, achieving euthermy passively by tracking daily fluctuations in ambient temperature, (b) high-plateau dwarf lemurs at Tsinjoarivo, hibernating underground at consistently low body temperatures, achieving euthermy using active thermogenesis during arousals; (c) a dwarf lemur hibernating at Tsihomanaomby, in a "warm" environment similar to Kirindy, but undergoing active thermogenesis as do lemurs from Tsinjoarivo. When body temperatures exceeded 30 °C, EEG recordings indicate that dwarf lemurs under all three conditions exhibit brain activity consistent with alterations between REM and non-REM sleep. As expected, the Tsihomanaomby dwarf lemur, who underwent thermogenesis under warm conditions, achieved euthermy and reached the maximum heart rate sooner than the others. Nevertheless, the magnitude of heart rate (~200 bpm) remained intermediate between Kirindy and Tsinjoarivo dwarf lemurs (~120 and 300 bpm) respectively. It is unknown if the magnitude and rate of physiological changes resulting from thermogenesis vs. thermocomforming under different environmental conditions pose health risks, or whether they safely allow dwarf lemurs to cope with ecological heterogeneity.

Influence of Female Reproductive State on Social Network Structure in White-bellied Spider Monkeys (*Ateles belzebuth*)

MARYJKA B. BLASZCZYK[1], CLARA J. SCARRY[1,2], ANTHONY DI FIORE[1,4] and ANDRES LINK[3,4]

[1]Department of Anthropology, University of Texas at Austin, [2]Department of Anthropology, Miami University, [3]Department of Biological Sciences and School of Business, Universidad de Los Andes, [4]Fundación Proyecto Primates

According to primate socioecological models, females distribute themselves in their environments according to the distribution of food resources, while males' sociospatial behavior is driven primarily by the distribution of fertile females. Among spider monkeys living in fission-fusion societies, fertile females are spatiotemporally dispersed, as females commonly travel alone or in small subgroups and females are only sexually receptive for a short period every few years. The presence of sexually receptive females should therefore have a pronounced effect on spatial association patterns within groups. We used social network analysis to examine differences in spider monkey association patterns in Amazonian Ecuador over two periods in 2011-2012, one in which no conceptive females were present and one in which ~ 1/3 of adult females were sexually receptive. We extracted data on subgroup association patterns for these two periods and constructed social networks for 13 adult individuals (8 females, 6 males) for which we had focal samples during each month of the relevant periods. Male-female dyads had significantly stronger associations when conceptive females were present, but male-male association patterns did not differ across the two periods. For the first period, with no conceptive females, females had lower social network strength and eigenvector centrality than males, but there were no sex differences in these network measures for the second period. Our results demonstrate some of the ways in which social network analysis can reveal changes in spatial association structure associated with variation in female reproductive state in a species characterized by fission-fusion dynamics.

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Somebody call a doctor!: Identifying limitations in using clinical data to interpret health in human skeletal remains from a Post-Medieval English cemetery

SARAH E. BLESSING and CHARLOTTE ROBERTS

Archaeology, Durham University

Skeletal indicators of interrupted growth and development have long been used to identify general health in past populations. However, using advances in clinical knowledge, correlated with skeletal evidence for early life health problems, can help bioarchaeological studies potentially identify health conditions in the past that can be found today. This contextually driven study considers the identification of indicators of child and later adult health (non-communicable diseases) in an archaeological population in relation to the theories proposed by the Developmental Origins of Health and Disease hypothesis (DOHaD). The study focuses on skeletons of a Quaker community dated from the 18th to 19th centuries, excavated from the Coach Lane cemetery in North Shields, England. A sample of 54 adults able to be identified for age and sex were analyzed (23 females and 31 males). Results from the skeletal data did not reveal strong evidence of the DOHaD hypothesis in showing the comparison between past clinical health conditions and modern clinical health conditions due to missing records documenting cause of death. However, the skeletal data suggests that the Coach Lane community experienced health hardships typical for individuals living in an industrial city during this period. The significance of this study highlights where further research is needed in linking early child health indicators in skeletal remains with non-communicable diseases in later adult life. In particular, while this is a development from previous work addressing the DOHaD hypothesis using archaeological human remains, it is not without it's challenges in interpretation.

Helton Mound 22 Crematory: An Examination of Late Woodland Mortuary Practices

BRITTNEY L. BLEVINS[1], SAMUEL A. MIJAL[2], ALIYA R. HOFF[3] and JANE E. BUIKSTRA[3]

[1]Department of Geography and Anthropology, Louisiana State University, [2]Department of Anthropology, California State University, Chico, [3]Center for Bioarchaeological Research, School of Human Evolution and Social Change, Arizona State University

The Late Woodland period in the Lower Illinois River Valley is characterized as a time of immense social change, as reflected by the diversity of mortuary practices. Mortuary practices of Late Woodland people are not as well-known as those of the Middle Woodland, in part due to the decline in numbers of burial accompaniments, which make the time period more difficult to study. Holistic understandings of the regional mortuary program are further constrained by the time-intensive process required to examine fragile cremated remains, resulting in cremations being understudied relative to other mortuary treatments.

This study reevaluates the initial analysis of the Helton mound 22 crematory, including estimating the minimum number of individuals as well as the biological sex and age of the individuals interred within. Degrees of burning and thermal fractures are also examined to infer the processing of individuals before cremation and the location and temperature of the fire during cremation. The cultural significance and practical applications of the crematory are explored through examination of thermal destruction patterning and the inclusion of culturally relevant material, such as red ochre. The Helton mound 22 crematory is compared to other crematories within the Helton mound group and to contemporaneous regional crematories to explore the diversity of cremation practices and to establish which individuals were eligible for the cremation burial track. This project aims to contribute to a more holistic understanding of mortuary practices during the Late Woodland time period of the Lower Illinois River Valley.

Searching for tuberculosis at a Mesoamerican Postclassic urban center

KELLY E. BLEVINS[1], JANE E. BUIKSTRA[1], ANNE C. STONE[1] and JOSEFINA MANSILLA LORY[2]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Dirección de Antropología Física, Instituto Nacional de Antropología e Historia

There is a puzzling absence of tuberculosis in ancient Mesoamerica, given its high-density population centers and the contemporaneous evidence in North and South America. Recently, a member of the *Mycobacterium tuberculosis* complex (MTBC) was identified in several pre-contact Peruvian skeletons; the strain was found to be closely related to those that infect seals and sea lions. This has generated more questions about other concurrent strains in the Americas, the movement of MTBC strains throughout the Americas, and the eventual replacement of this strain, as all contemporary tuberculosis strains infecting humans in the Americas are derived from European lineages. The aim of this project was to characterize the presence of tuberculosis in the Postclassic basin of Mexico, specifically at Tlatelolco, sister-city of the Aztec imperial capital, Tenochtitlan. Tlatelolco experienced rapid urban development after its formation in 1338 AD and housed the largest marketplace in Mesoamerica at the time of Spanish contact in 1519 AD. We hypothesize that this rapid urban development combined with the daily, massive market facilitated tuberculosis infection at Tlatelolco. Ancient DNA was extracted from bone (n = 5), calculus (n = 2), and dentine (n = 3) from three pre-contact Tlatelolco individuals with skeletal lesions suggestive of tuberculosis infection. These samples were screened using qPCR assays; one individual was positive for tuberculosis using the rpoB2 gene, IS6110, and IS1081 assays. This suggests a member of the MTBC was present in the Postclassic basin of Mexico and, given its presence in an urban center, was adapted to human-human transmission.

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Presence or absence of tuberculosis in ancient skeletal samples from Ukraine

TRE BLOHM[1], JORDAN KARSTEN[1] and RYAN SCHMIDT[2]

[1]Anthropology, University of Wisconsin-Oshkosh, [2]Archaeology and Earth Institute, University College Dublin

This research aims to investigate biocultural interactions by studying ancient disease among the Tripolye, one of the first agricultural populations in Eastern Europe. Specifically, this project seeks to use biomolecular methods of ancient DNA extraction, amplification, and identification using gel electrophoresis of a specific genetic element known as insertion sequence 6110 (IS6110) to identify the presence of tuberculosis in this late Neolithic group (4,900-2,900 calBC). As one of the first farming societies in the region, the Tripolye lived at much higher population densities and had closer contact with bovines than the hunter-gatherers that came before them. This provides the biocultural context for tuberculosis to be transmitted from cattle to humans. Through this investigation, we can achieve a better understanding of cultural processes on human health, the antiquity of tuberculosis, and European prehistory. The results of the gel electrophoresis show banding patterns of the genetic element suggestive of the presence of the tuberculosis complex in three out of four samples of bones showing lesions characteristic of tuberculosis.

Funding for this project was obtained through the Student/Faculty Collaborative Undergraduate Research Grant from the University of Wisconsin-Oshkosh.

Linearity and stability in Ring-Tailed Lemur (*Lemur catta*) dominance hierarchies

MARIAH F. BLOOM[1], COLIN M. BRAND[1], COLIN M. OLIVERA[1], TIMOTHY KEITH-LUCAS[2] and FRANCES J. WHITE[1]

[1]Anthropology, University of Oregon, [2]Psychology, University of the South

Social dominance, as determined from decided social interactions, is an important but long debated aspect in animal sociality. Different species have evolved different patterns and intensity of typical dominance hierarchies. Hierarchies can differ greatly in their linearity with depending on the consistency of decided interactions within each dyad and transitive triadic interactions. Ring-Tailed Lemurs (*Lemur catta*) are known to have strong dominance hierarchies with adult females typically outranking adult males. Previous research has found strong linear dominance hierarchies in wild Ring-Tailed Lemurs, however, it is unclear if linearity changes during periods of social instability such as male and female rank changes with age. We predicted that Ring-Tailed Lemurs would have highly linear hierarchies and that this linearity would decrease during periods of rank instability. Interaction data were collected in 2013 on a group of free-ranging Ring-Tailed Lemurs (the Windmill troop) on St. Catherine's Island, Georgia. Using data on adult females and males, we constructed dominance hierarchies and calculated the dominance linearity (h') for each month and this data was compared to changes in rank associated with an aging alpha male and female. The dominance hierarchy changed from being non-linear (h'= 0.29, ns) during the unstable period to being significantly linear (h'=0.75, $p<0.001$) after the rank changes. Our data shows that linear hierarchies become unstable during rank change but return to linearity with the establishment of new dominance positions.

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Effects of female reproductive state on male mating interest and female proceptivity in the chimpanzees (*Pan troglodytes schweinfurthii*) of Gombe National Park, TZ

EMILY E. BOEHM

Evolutionary Anthropology, Duke University

Exaggerated sexual swellings in female chimpanzees (*P. troglodytes*) signal sexual receptivity, but offer imperfect information about fertility.

Because they promote mating beyond the periovulatory period, exaggerated swellings contribute to paternity confusion and reduce the risk of male infanticide for females. Sexual swelling and copulation can also occur during pregnancy. This is surprising given the evidence that male chimpanzees are sensitive to subtle changes in swellings and prefer mating when conception is most likely. One hypothesis is that male mating interest is reduced for pregnant females, but females can compensate with increased proceptivity. I tested whether male interest and female proceptivity differed based on female reproductive state (pregnant or cycling). Courtship behaviors (branch shaking, penile and dominance displays, piloerection) indicated male mating interest; female vocalizations and approach leading to copulation indicated female proceptivity. I used generalized linear mixed models to analyze 422 copulations observed between September 2014-May 2015. All models controlled for male and female age and repeated measures of individuals. Contrary to my predictions, I found that female reproductive state was not a significant predictor of male courtship behaviors (n = 264 copulations, p = 0.133). Female reproductive state also failed to predict female vocalizations (n = 328, p = 0.234) and approach (n = 320, p = 0.420). These preliminary results suggest that post-conception swellings are deceptive; pregnant females do not increase proceptivity to achieve mating success. This analysis provides further support for the role of post-conception swellings in paternity confusion and infanticide avoidance among female chimpanzees.

First report of wire snares at the Mount Assirik Research Site in Niokolo-Koba National Park, Senegal

STEPHANIE L. BOGART[1], MALLÉ GUEYE[2], PAPA IBNOU NDIAYE[3], NATALIA G. ROBERTS BUCETA[1], GRACE A. MAROTTA[1] and STACY M. LINDSHIELD[4]

[1]Human and Evolutionary Biology, Department of Biological Sciences, University of Southern California, [2]Direction des Parcs Nationaux, SENEGAL, [3]Department of Animal Biology, Université Cheikh Anta Diop, [4]Department of Anthropology, Purdue University

Niokolo-Koba National Park (NKNP) in Senegal is a World Heritage site listed as 'in danger' by UNESCO (2007) due to poaching and cattle grazing. The launch of Mount Assirik Research Site (MARS) was in July 2015 for long-term primate research. Here we report on evidence of poaching around Assirik and aim to highlight the need for resources to support Senegal's park services to increase maintenance of NKNP. Data were collected over six months in July 2015 and January-May 2016. Methods included six camera traps (155 days, *N*=49,177 photos, 17 locations), line-transects (*N*=16, 1.28km^2), along with opportunistic encounters with chimpanzees, mammals, and evidence of human presence during reconnaissance walks. Illegal activity was recorded on a total of six days, including meat drying structures and fire pits, mining pits, shotgun shells, and gunshots heard. A hunter was captured on camera in January. Finally, a series of several photos captured an injured adult male baboon (*Papio papio*) with a wire snare around his arm. Initially, the snare was clearly seen around the individual's left arm in March. Photos 10 days later displayed a more severe injury with tissue gloving and bone exposure. In May 2016, photos showed a severed left arm of potentially the same baboon. This is the first reported case of wire snare use in NKNP and are generally rare in Senegal. Given the short time-period of this study, the evidence of poaching is of concern and it demonstrates the need to implement snare detection and removal programs at NKNP.

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The diet of *Graecopithecus freybergi*: phytoliths and dentognathic evidence

MADELAINE BÖHME[1,2], SABINE KÖTTER[1] and JOCHEN FUSS[1,2]

[1]Geoscience, University Tuebingen, [2]Centre for Human Evolution and Palaeoenvironment, Senckenberg

Reconstructing the diet of human ancestors is a complex but significant scientific challenge, because it may provide another way to understand our own biology. Here we report on our preliminary results about possible dietary adaptations and nutritional condition of the earliest potential hominin *Graecopithecus freybergi*, which lived in dry C4-grass rich savannah about 7.2 Ma ago in the Balkan Peninsula.

Previous investigations of microwear patterns characterized this species as a hard-object feeder. Our new analysis proceeds by examining mastication-related internal and external dentognatic features using µ-CT analysis. We also explore potentially available food resources using palaeobotanic data as phytoliths and pollen. Furthermore, based on geologic mapping and hydrogeologic data, we survey for drinking water availability for *Graecopithecus*.

Our data suggest dietary specialisation of *Graecopithecus freybergi*. Results will be discussed in the framework of hominid metabolism and have potential implications towards better understanding of subsistence strategies of hominins in savannah environments.

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Late juvenile *H. naledi* partially articulated lower limb from Dinaledi Chamber, South Africa

DEBRA R. BOLTER and MARINA C. ELLIOTT

Evolutionary Studies Institute, University of the Witwatersrand

To date, over 1700 commingled bone fragments and teeth of a minimum of 15 *Homo naledi* individuals have been recovered from the Dinaledi Chamber, Rising Star Cave, in South Africa. These individuals represent all age classes, from infant to old adult. The vast majority of the remains are isolated and unassociated, having been subjected to geological movements and depositional shifts of the chamber floor over the last 236,000-335,000 years. Here, we report a rare example of associated lower limb elements in the Dinaledi Chamber: a complete but immature left tibia with associated proximal and distal epiphyses (U.W. 101-1070), a refitted and nearly complete left fibula (U.W. 101-1045), along with a partial calcaneus (U.W. 101-907), and a weathered talus and navicular (U.W. 101-910). Developmentally, the elements are consistent with a late juvenile, comparable in life stage to *A. sediba* MH1 and *H. erectus* WT15000. The findings contribute to our growing database and understanding of hominin ontogeny.

Taking rests changes the heart rates and core temperature of women and men during canoeing

AZARIEA BONNER-HARRIS[1] and CARA M. WALL-SCHEFFLER[1,2]

[1]Department of Biology, Seattle Pacific University, [2]Department of Anthropology, University of Washington

It has been noted by many researchers that groups of people out foraging stop and rest at regular intervals; it is possible that the number and length of time of these rests leads to a reduced heat load and/or increased metabolic recovery associated with the task itself. Thus, by constantly bringing the body back to a baseline, humans might actually be able to work for absolutely longer than they would without the timely breaks. Here we look at rowing speeds, heart rate (HR), and core body temperature during bouts of canoeing. People (N=16) paddled continuously across an outdoor lake for 6- or 12- minute bouts interspersed with short and long rests. When people preceded short bouts of rowing with a long rest they had significantly lower HRs during the row than when they only took a short rest (p=0.038), even though there were no differences in the speeds that were rowed (p=0.232). Women seemed particularly sensitive to rests, and showed HR and core temperature values closer to resting levels during longer rests (p=0.011 for HR; p=0.127 for core temperature). Men showed significantly different patterns (p=0.017) than women for HR, and showed an increase in HR

across the experimental periods, regardless of rest lengths. Men's core temperatures also increased regardless of rest length, whereas women maintained core temperatures closer to resting temperatures during the longer rest periods; the differences between the sexes were not significant (p=0.451), most likely because of the larger variation in absolute core temperatures.

Male-immature interactions in bonobos (*Pan paniscus*) and the relationship to testosterone, male reproductive behavior, and affiliation with mothers

KLAREE J. BOOSE[1], FRANCES J. WHITE[1], AUDRA MEINELT[2] and JOSH SNODGRASS[1]

[1]Anthropology, University of Oregon, [2]., Columbus Zoo

Among primate males, the allocation of energy between mating and parenting effort represents a major life history trade-off and is regulated, in part, by testosterone. Testosterone mediates male mating effort at the expense of affiliative interactions with immatures and females, particularly in species where rank is correlated with mating success. Human males, however, show there is considerable behavioral and endocrine plasticity in relation to direct paternal care and male-female bonds. Little is known about these mechanisms in great apes, who are valuable in modeling the contextual parameters that may have shaped paternal phenotypes in early hominins. This study presents data on the relationship among testosterone, interactions with immatures, reproductive behavior, and affiliation with females in male bonobos at the Columbus Zoo. Among all males, interactions were not equally distributed across immatures (for six males: G=9.519, 13.331, 4.074, 10.67, 10.126, 16.009, respectively; df=4 and p<0.05 for all males), but there was no preference for related individuals. Across all males, both rank (R^2=0.593, p<0.05) and affiliation with females (R^2=0.762, p<0.05) were correlated with copulations, but there was no significant relationship between testosterone and either rank (R^2=0.004, p=0.222) or affiliation with females (R^2=0.049, p=0.336). Among low-ranking males, interactions with immatures were positively correlated with copulations (R^2=0.953, p<0.05) and were negatively correlated with testosterone (R^2=0.838, p<0.05). These results support the hypothesis that male bonobos show rank-based flexibility in reproductive strategy where testosterone is down-regulated in males as mating strategies are driven by affiliation with immatures and proximity to their mothers.

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Anthropogenic disturbance as a determinant of gut microbiome structure in Madagascar's ring-tailed lemurs (*Lemur catta*)

SALLY L. BORNBUSCH[1], LYDIA K. GREENE[2] and CHRISTINE M. DREA[1]

[1]Evolutionary Anthropology, Duke University, [2]University Program in Ecology, Duke University

The mammalian gut is home to a community of trillions of bacteria, termed the 'gut microbiome' (GMB), which co-evolved with the host and plays a critical role in host health and ecology. More recently on the evolutionary timescale, anthropogenic disturbances, including "unnatural" diets or antibiotic use, have altered host-microbe relationships. While the consequences of these disturbances are well-studied in humans, their impacts on wild and captive non-human primates remain unclear but are likely to be severe. Many natural habitats are influenced by anthropogenic disturbances, such as deforestation and agricultural contamination, which can affect wildlife GMBs through shifts in diet or exposure to contaminants. Similarly, captive animals experience altered diets, contaminated soil and water, and antibiotic administration, which influence the GMB. Here we use 16S rRNA sequencing to investigate patterns of GMB structure in wild and captive ring-tailed lemurs (*Lemur catta*) living along a gradient of anthropogenic exposure: pristine wild habitats, disturbed wild habitats, a captive rescue center, and Malagasy households. We expect increased anthropogenic disturbance to result in altered GMB composition and decreased diversity. Consistent with our hypothesis, the GMBs of captive *L. catta* show lower diversity and divergent composition from wild conspecifics. Additionally, the GMBs of wild *L. catta* have high diversity with a core composition that shows little variation across wild populations. These results elucidate the varied effects of anthropogenic disturbance on primate GMBs and can inform captive management procedures and wildlife conservation efforts. Future research will explore the effects of these patterns on host health.

Exploring the contribution of South Africa's flora to the diet of early humans

SUSAN M. BOTHA[1], ALASTAIR J. POTTS[1], RICHARD M. COWLING[1], KAREN J. ESLER[2] and JAN C. DE VYNCK[1]

[1]African Centre for Coastal Paleoscience; Botany Department, Nelson Mandela University, South Africa, [2]Conservation Ecology & Entomology & Centre for Invasion Biology, Stellenbosch University, South Africa

The GCFR, in particular its southern Cape coast, has received significant attention because it hosts the earliest evidence of human cultural material complexity. We sought to understand how this region's flora contributed to the diet and thus aided the survival of early *Homo sapiens*. First, we enquired which plant species were used by humans in the past by establishing whether the same suite of plant species known and used today were also utilised in the archaeological past. We then conducted monthly plant foraging excursions over two years with the help of the area's local inhabitants who are of Khoe-San (early indigenous inhabitants of southern Africa) descent. Finally, we examined plant resource depletion by harvesting designated plots for indigenous foods once yearly over three consecutive years. There are a significant number of plant species (63) that are shared between the contemporary utilised species and those excavated from archaeological sites within the same area. Potential reasons for mismatch include incomplete archaeological and contemporary databases and a preservation bias in the archaeological records. Sixty-seven participants contributed to 546 foraging bouts in seven different vegetation types. Edible weight returns varied widely with season, vegetation type and across the landscape. Our depletion study showed that plant species are remarkably resilient, surviving partly because human foragers harvest selectively and plant species show high yearly variability in emergence patterns. We confirm that the southern Cape can contribute towards the diet of human foragers but that processing methods for certain species were required.

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The Canopic Jar Project: an interdisciplinary study of ancient Egyptian soft tissue remains

ABIGAIL S. BOUWMAN[1], THOMAS KRÄMER[2], MICHAEL HABICHT[1], PATRICK EPPENBERGER[1], ROGER SEILER[1], FRANCESCO GALASSI[1] and FRANK RÜHLI[1]

[1]Institute of Evolutionary Medicine, University of Zurich, [2]Institute of Forensic Medicine, University of Zurich

The Canopic Jar Project is examining a larger series of ancient Egyptian human soft tissues samples in a truly interdisciplinary research setting (medical, genetic, chemical and Egyptological) from canopic jars and visceral bundles in European (e.g. Museo Egizio Turin) and American museum (e.g. Boston Museum of Fine Arts) collections. The aim is a.o. to radiologically locate and identify tissue types, as well as individual tissue-specific microbiome patterns. For the first time radiography based (CT, MRI) volumetric calculations, allowed a quantitative assessment of the contents with consequent implications for the applied sampling methods and required sample size (Total jar volumes c. 600 - 1300 cm^3, corresponding tissue volumes c.

200 - 1000 cm^{3}). The high content of embalming materials in the retrieved samples presents particular challenges beyond those usually encountered when analyzing similar ancient DNA. To identify inhibitors of DNA extraction and downstream applications, we analyzed the chemical composition using high-resolution gas-chromatography tandem mass spectrometry, whereby c. 2700 components were identified. After testing of various extraction techniques to retrieve DNA of sufficient quality and quantity for Next-Generation Sequencing we have yielded metagenomic data from selected canopic jars. Here we present preliminary data, including two 18th dynasty jars containing different organs of the same individual, Wadj-ren, showing very different taxonomic profiles (Museo Egizio, Turin: Cat. 3459 A (RCGE 8156) stomach, 3459 C (RCGE 8156) liver). This interdisciplinary study not only improves our understanding of the funerary practices of ancient Egypt, but, trough metagenomic data from specific organs, also launches historical microbiome research.

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Pollical metacarpal shaft morphology in *Homo naledi*: a 3D geometric morphometric analysis

LUCYNA A. BOWLAND[1], JILL E. SCOTT[2,3,6], TRACY L. KIVELL[4,5,6], BIREN A. PATEL[7,8], MATTHEW W. TOCHERI[10,4,9] and CALEY M. ORR[1,11]

[1]Anthropology, University of Colorado Denver, [2]Sociology and Anthropology, Metropolitan State University of Denver, [3]Anthropology, The University of Iowa, [4]Animal Postcranial Evolution Lab, Skeletal Biology Research Centre, School of Anthropology and Conservation, University of Kent, [5]Human Evolution, Max Planck Institute for Evolutionary Anthropology, [6]Evolutionary Studies Institute and Centre for Excellence in PalaeoSciences, University of the Witwatersrand, [7]Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [8]Human Evolutionary Biology Section, Biological Sciences, University of Southern California, [9]Anthropology, Lakehead University, [10]Human Origins Program, National Museum of Natural History, Smithsonian Institution, [11]Cell and Developmental Biology, University of Colorado School of Medicine

The *Homo naledi* skeleton provides important insights into anatomy that may have characterized basal species of the genus *Homo*. The hand in particular exhibits an interesting combination of primitive and derived traits. The pollical metacarpal (Mc1) is especially unusual with a sharp median longitudinal crest and pronounced muscle entheses. Here we present a 3D geometric morphometric analysis of Mc1 shaft morphology designed to further characterize the *H. naledi* thumb relative to a sample (n = 337) of humans, apes, monkeys, and other fossil hominins. A 20 x 20 semilandmark grid was placed across 3D virtual renderings of the Mc1 palmar diaphyseal surface and subjected to a principal components analysis of Procrustes shape variables while multiple regression was used to explore size effects.

The results show *H. naledi* is distinguished from other hominins by the combination of a diminutive proximal base and gracile shaft distally mounted with broad muscle flanges. The gracility of the proximal shaft and base is similar to cercopithecids, *Pongo*, *Pan*, *Australopithecus afarensis*,and *A. sediba*, indicating this is likely plesiomorphic for hominins. In contrast, Neandertal Mc1s (and SK 84) are distinguished by robust bases, pinched midshafts, and wide opponens pollicis crests, while modern human bones exhibit robust bases and straight shafts with moderate enthesis development. These results suggest early evolutionary modifications to the thumb in the genus *Homo* involved larger or intensified recruitment of intrinsic muscles attached to an otherwise gracile metacarpal, advancing our understanding of the evolution of manipulative capabilities facilitating the elaboration of hominin tool behaviors.

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Arterial canals and brain metabolism in Euarchonta

DOUG M. BOYER and ARIANNA R. HARRINGTON

Evolutionary Anthropology, Duke University

Although large brains may have cognitive benefits, they also incur significant metabolic energy costs. The human brain is thought to be exceptionally expensive with energy demands comprising 25-30% of basal metabolic rate (BMR). Many scenarios for human evolutionary origins invoke this exceptional cost. However, rates of brain metabolic energy consumption have only been measured in a few species. Until brain energy consumption can be observed or estimated more broadly, evolutionary implications of relative brain cost in humans will remain ambiguous. We sought to understand whether brain energy consumption is predictable from anatomical traits. While previous research suggests neuron counts can predict energy consumption, this precludes assessment of fossils and extant species without fresh cadavers. Since larger arteries allow greater blood volumetric flow rates (and blood flow can be a proxy for energy flow), we predicted that encephalic arterial canal diameter should correlate with brain energy consumption. Using multiple regression on a sample of gliroids (rodents and lagomorphs) and euarchontans (primates, treeshrews, and dermopterans) we determined that the diameters of bony canals transmitting encephalic arteries to the brain explain more variance in direct measures of brain metabolic energy consumption than do neuron counts and (in some analyses) brain size. Thus, we constructed a Bayesian phylogenetic prediction model of brain metabolism incorporating arterial canal diameter and endocranial volume. Results indicate that humans have higher relative brain costs than gliroids, old world monkeys, and chimps, but that certain platyrrhines, lemurs, tarsiers and treeshrews have brains that account for 25-30% of BMR, like humans.

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Impacts of artisanal small-scale gold mining on chimpanzee habitat use and behavior

KELLY BOYER ONTL[1] and JILL D. PRUETZ[2]

[1]Department of Social Sciences, Michigan Technological University, [2]Department of Anthropology, Texas State University

Despite its global pervasiveness, little systematic research has been conducted on the impact of artisanal small-scale gold mining (ASGM) on terrestrial wildlife. Our study assesses the impacts of human activity associated with ASGM on a community of West African savanna chimpanzees (*Pan troglodytes verus*) living in a complex human and natural system. Research was conducted in southeastern Senegal where a recent spike in ASGM has increased the local human population, caused environmental pollution and degradation, and threatens the habitat of the critically endangered apes. To assess the impacts of ASGM, we analyzed 10 years of chimpanzee observational data from the Fongoli Savanna Chimpanzee Project. Despite the small footprint of ASGM activity at the Fongoli field site (0.04% of the home range), we found significant changes in chimpanzees' ranging and behavior. When the chimpanzees were observed at the mines, they used anthropogenic areas significantly more than they had prior to mining activity. They inspected materials left by miners and drank water from mining pits. Use of mined areas, however, occurred primarily when miners were not present and varied with land cover type. Increased use of the mines may be attributed to direct observational learning of a novel disturbance to understand and assess potential risks. However, the risks associated ASGM activities, including mercury pollution, exposure to human fecal pathogens, and uncovered and abandoned pits, are likely to go unperceived and pose a more insidious risk for chimpanzee conservation.

Iliac flare is related to body mass and gut size in apes, but not in monkeys

EVE K. BOYLE[1] and SERGIO ALMÉCIJA[1,2]

[1]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, Washington, DC,

[2]Institut Català de Paleontologia Miquel Crusafont (ICP), Cerdanyola del Vallès, Barcelona, Spain

In primates and some other mammals, iliac flare, or the lateral expansion of the upper ilium relative to the lower ilium, appears to be greater in larger species (e.g., great apes) than in their smaller-bodied relatives. Several studies have shown that the primate upper iliac blade scales with positive allometry, but it is unclear how lower ilium width scales with body size, and how lower ilium scaling affects the appearance of iliac flare across primates. Furthermore, though there is certainly a locomotor effect on iliac blade allometry, some researchers have suggested that iliac flaring is greater in larger species, in relation to gut size scaling.

Here, we used phylogenetic generalized least squares (PGLS) regression to test how upper and lower ilium widths, and the ratio of these two measurements ('iliac flare') scale with body mass in 32 anthropoid species (n = 134 individuals). We also examined the relationship between iliac flare and 'gut size' (approximated by surface area) for the 24 species in our sample for which these data are available. Our results indicate that whereas upper ilium width scales with positive allometry (as previously shown), lower ilium width scales isometrically, both effects combined causing differences in iliac flare. Though flaring increases with body mass across the entire sample, this is driven by apes because there is no relationship between flare and body mass when apes are excluded. Finally, although there is no relationship between flare and gut size in monkeys, flaring increases as gut size increases in apes.

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Assessing biomechanical hypotheses about hind-limb elongation in jumping Primates using Longshanks mice

MADISON M. BRADLEY[1] and CAMPBELL P. ROLIAN[1,2]

[1]Anthropology and Archeology, University of Calgary, [2]Department of Comparative Biology and Experimental Medicine, University of Calgary

Jumping is a common mode of locomotion among primates. Primates who are specialized jumpers have converged on a similar body plan characterized by gracile and elongated distal hind-limb elements relative to body size and to forelimb length. This body plan is hypothesized to improve jumping performance by increasing the distance and time over which limb muscles contract and generate force, thereby increasing take-off velocities and jumping distance. We tested this hypothesis using Longshanks mice, which were selectively bred for over 20 generations for increased tibia length relative to random-bred controls. We trained age- and mass-matched mice (n= 5 controls, n= 11 Longshanks line 1, n=15 Longshanks line 2) to jump for a food reward onto a raised platform within a filming enclosure. Following training, we filmed the jumps to three height intervals (h= 6cm, 10cm, 14cm) at 250 fps using high-speed cinematography. Integration of force plate data with the film data allowed for direct measurement of the forces generated by the hind-limb musculature. Our results show that behaviorally, Longshanks mice achieved greater jump heights more frequently. Moreover, Controls required greater forces and higher take-off velocities than Longshanks to successfully execute even the lowest height jumps. These data suggest that, although both groups can jump to similar heights, Controls do so less efficiently than Longshanks. Our results provide evidence in support of the hypothesized link between hind-limb elongation and jumping performance within a mammalian population, and thus have implications for the interpretation of analogous fossil primate material.

Smartphone Photogrammetry: Creating a Quick and Easy Recording Method for Forensic Crime Scenes

WILLIAM BRADLEY[1] and CHRISTINE A. JONES[2]

[1]Texas Bioscience Institute, Temple College, [2]Social Sciences, Texas A&M University Central Texas

This project was developed to test the suitability of methods in photogrammetry for use in both crime scenes and lab settings. The authors compared camera quality, availability, number of photos, time required to photograph, and ease of camera against the quality of 3D model that can be produced. A Canon Rebel t3i DSLR, iPhone 5s, and GoPro hero 3 were used to photograph a forensic dummy in a mock crime scene and an anatomical human skull in a lab setting. The DSLR produced the most accurate 3D models with the least amount of photos taken, making it the fastest, best and highest cost option. The iPhone 5s also produced high quality models, though they were less accurate than the DSLR and required more photos to capture detail, making the iPhone the best option for ease of use, low cost, and availability relative to quality. The GoPro produced low quality models and is not recommended in either setting as the 170 degree angle of its camera produces photos that are not compatible with Autodesk software. Since smartphones are readily available, this project demonstrates that photogrammetry can be used to create models quickly and inexpensively in forensic or lab settings with minimal funds or access to professional cameras or 3D scanners, such as in rural areas or developing countries. Using a smartphone and Autodesk, crime scene or lab subjects can be photographed and the photos converted into high quality shareable 3D models in 2 hours or less.

Adaptive functions of GG rubbing among female bonobos (*Pan paniscus*) at Lomako, DRC

COLIN M. BRAND[1], FRANCES J. WHITE[1], NANCY THOMPSON HANDLER[2], ALEXANA J. HICKMOTT[1] and KLAREE J. BOOSE[1]

[1]Anthropology, University of Oregon, [2]Anthropology, Yale University

Genito-genital (GG) rubbing is a unique bonobo socio-sexual behavior. Five hypotheses have been proposed to explain this behavior: 1) reconciliation, 2) mate attraction, 3) tension regulation, 4) dominance, and 5) social bonding. Previous research has found mixed support for several of these hypotheses. We tested three of these hypotheses by collecting ecological data on 133 visits to food patches and interaction data from two independent but overlapping studies (242 hours, 414 hours) on three bonobo communities at the N'dele site in the Lomako Forest, DRC. Mating and male attraction accounted for 20% of the behavior following GG rubbing, following feeding and more GG rubbing in frequency. We found that the amount of food removed from a food patch significantly explained variation in GG rubbing ($F = 5.16$, $p < 0.0001$), such that females GG rubbed more frequently in abundant food patches. GG rubbing was not significantly correlated to other measures of affiliation: grooming ($r = 0.16$, ns), nearest neighbor ($r = 0.20$, ns), or party preference ($r=0.16$, $p = 0.06$). GG rubbing also occurred more frequently than expected between nulliparous females. Collectively, these results support the mate attraction and social bonding hypotheses but do not support the tension regulation hypothesis. This analysis also substantiates the important role of ecology in the evolution of female bonding in bonobos.

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Variables influencing cortisol levels during motherhood in wild Bornean orangutans

TIMOTHY D. BRANSFORD[1,2], MELISSA EMERY THOMPSON[3], DANIEL J. NAUMENKO[1,2,4], MARIA A. VAN NOORDWIJK[5], SRI SUCI UTAMI ATMOKO[6] and ERIN R. VOGEL[1,2]

[1]Department of Anthropology, Rutgers, the State University of New Jersey, [2]The Center for Human Evolutionary Studies, Rutgers, the State University of New Jersey, [3]Department of Anthropology, University of New Mexico, [4]Department of Anthropology, University of Colorado, Boulder, [5]Department of Anthropology, Universität Zürich, [6]Fakultas Biologi, Universitas Nasional, Jakarta

The extended period of infant dependency in Bornean orangutans (*Pongo pygmaeus wurmbii*) spans across periods of unpredictable and often low fruit availability, which can be stressful for mothers who must obtain sufficient energy for sustaining lactation. Glucocorticoids, such as

cortisol, regulate glucose availability in the body and are produced in response to both dietary and social stress. Yet, little is known about how cortisol varies with the availability of preferred fruit or throughout the 8-9 year period of infant dependency. We examined if an adult female's cortisol level varies across infant development and episodes of fruit scarcity. We collected urine samples from eight females with infants of different ages at the Tuanan Research Station in Central Kalimantan, Indonesia between 2012-2015. We measured urinary cortisol, quantified by an enzyme-linked immunoassay (Arbor Assays). Preliminary results indicate that a mother's cortisol levels are not related to fruit availability ($p = 0.84$), but that a mother's cortisol levels are greater when her infant is at least six years old ($p = 0.03$), relative to other infant age categories. Mother orangutans with larger, more independent infants associate with adult males more often than when their infants are young, presumably because they are receptive. These encounters can be stressful and may drive the higher cortisol levels. Our results add support to previous studies on mother orangutan energetic balance and caloric intake that suggest mother orangutans have both behavioral and physiological adaptations to cope with periods of high energetic demand (lactation) and fruit scarcity.

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Toeing the line: Morphology and biomechanics of metatarsus varus in three dimensions — a case study from the Milwaukee County Poor Farm Cemetery

ASHLEY L. BRENNAMAN and JESSICA L. SKINNER

Department of Anthropology, University of Wisconsin-Milwaukee

Metatarsus varus, colloquially termed in-toeing gait, is the result of atypical torsional alignment of the lower limb. While the severity varies, three characteristics are commonly associated with its expression: femoral anteversion, medial tibial torsion and metatarsal adduction. These characteristics, along with patented corrective devices and surgical procedures, were identified in medical literature from the turn of the twentieth century, which contextualizes the condition within a historical framework. This study combines traditional osteometric measurements and three-dimensional scanning to assess the presence and degree of metatarsus varus in an individual from the Milwaukee County Poor Farm Cemetery (ca. 1882-1925). Age and sex assessment indicated an adult male with a mean age of 53.1 years. Presence of the condition was confirmed through assessment of dry bone morphology and metrics, as well as through three-dimensional modeling. Elements were scanned using a NextEngine UltraHD 3D scanner. The utility and accuracy of each method is compared. Torsional measurement of the dry bone indicated bilateral asymmetry in the femur with 11° of anteversion on the right and 5° of retroversion on the left. The femoral neck shaft angle was also asymmetric (right = 130°; left = 122.5°). Measurements of medial tibial torsion in dry bone demonstrated angles of 26° and 27.5° for the right and left sides, respectively. Three-dimensional measurements of the feet presented a moderate medial diversion of the talar neck (30°) and a moderate medial talometatarsal angle (20°). The biomechanics of gait are discussed with reference to the historical perception and treatment of metatarsus varus.

Bushbaby (*Galago moholi*) nest site activity during the dry season at Loskop Dam Nature Reserve, South Africa

CLAIRE BRESNAN[1], KRISTA FISH[1], IAN RAY[2,3] and BRANDI WREN[1,3]

[1]Anthropology, Colorado College, [2]Education, University of Denver, [3]Primate Studies, Sepela Field Programs

Southern lesser bushbabies (*Galago moholi*) utilize nests but behaviors at nest sites are not well-documented. From 7 - 12 June and 26 June - 4 July 2017, we placed a camera trap outside a nest located in the roof of a researcher cabin in Loskop Dam Nature Reserve, South Africa. The camera was turned on at approximately 16:00 each evening and turned off at approximately 07:30 the next morning.

Results of camera trapping revealed that the nest was utilized by 1 - 3 bushbabies each night. Bushbabies left the nest an average of 21 minutes after sunset and within 2 – 3 minutes of each other. Individuals returned to the nest up to three times per night, and behaviors during these visits included urine washing on the roof above the nest as well as visual inspection of the nest without entering it. Final returns to the nest occurred 13 – 37 minutes before sunrise. After returning to the nest, bushbabies remained outside the nest for an average of 16 minutes while individuals groomed and made brief (<3 mins.) trips away from the nest. On two mornings, bushbabies spent 26 – 27 minutes making brief trips away from the nest and returning with twigs that were then brought into the nest. Vegetation assessments of the area surrounding the cabin and efforts to identify twig species from camera trap images suggest that bushbabies acquired twigs from non-acacia trees common in the area, including *Combretum* spp. and *Grewia* spp.

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Structural Violence and Disease: Epistemological Considerations for Bioarchaeology

LISA N. BRIGHT and JOSEPH T. HEFNER

Anthropology, Michigan State University

Bioarchaeologists have been examining the concepts of health, disease, and stress from the beginning. Although bioarchaeology has moved beyond the descriptive approach and embraced larger theoretical frameworks, the reality of integrating and examining the intricate biocultural processes shaping health and disease has remained a central issue. Health and disease cannot be disassociated from the larger socio-political context and biological responses must be considered within the global/regional politico-economic structures shaping the local context of people's lives.

Structural violence as a theoretical framework integrates social structures suppressing agency with the impairment of the social, economic, and biological potential of an individual or group. Although cultural and medical anthropology has repeatedly made the link between structural violence and disease, this concept has not been widely applied within bioarchaeology. Additionally the framework requires a rigidly-hierarchical society, and a deeply embedded engagement with archaeological and historic contexts appropriately applied.

This paper examines the paleopathology of the Santa Clara Valley Medical Center Historical Cemetery (1875-1935) within the framework of structural violence. Between 2012-2014 construction activity necessitated the exhumation of 1,004 individuals from this county potter's field, located in San Jose, California. This framework allows contextualization of widespread socio-political issues assessed in conjunction with skeletal pathological conditions creating a more holistic interpretation of historic skeletal data.

Investigating molar crown shape variation of australopithecines at Sterkfontein and Makapansgat, South Africa

JULIET K. BROPHY[1,2] and DARRYL J. DE RUITER[2,3]

[1]Geography and Anthropology, Louisiana State University, [2]Evolutionary Studies Institute and Centre for Excellence in PaleoSciences, University of the Witwatersrand, [3]Anthropology, Texas A&M University

Australopithecus africanus has been recovered from the sites of Taung, Sterkfontein, Makapansgat, and Gladysvale in South Africa. Clarke (2008; 2013) suggests that the specimens from Sterkfontein and Makapansgat should be divided into two species, *A. africanus* and *A. "prometheus"*, while others lump them into one highly variable species, *A. africanus*. This research uses an elliptical fourier analysis of tooth crown

shapes to test whether the *A. africanus* hypodigm is taxonomically heterogeneous. Crown outlines of maxillary and mandibular first and second molars were obtained from specimens identified by Clarke as *A. "prometheus"* and compared with *A. africanus* using principal component and cluster analyses. The results of the analyses suggest that the *A. "prometheus"* specimens are not distinct from *A. africanus*. The pc plots illustrate that, while the M_1s of *A. "prometheus"* fall closest to each other, the range of variation for the four available tooth types is encompassed within the variation for *A. africanus* and is not consistent with being attributable to more than one species. The cluster analyses do not indicate that *A. "prometheus"* teeth have a stronger affinity with each other than for *A. africanus*. Therefore, the shape of the crown outlines do not support a second species designation at Sterkfontein and Makapansgat.

Evaluating the efficacy of machine learning approaches to the estimation of age-at-death using 3D scans of the pubic symphyseal face

MELISSA A. BROWN, DILLON DAUDERT and JAMES JENKINS

Anthropology, Western Michigan University

The problematic aspects of estimating age-at-death through phase scoring methods are particularly important to resolve in forensic contexts where accuracy of the biological profile is paramount and methodology is subject to court admissibility standards. This project furthers trends within anthropology to establish more accurate methods for the determination of age-at-death by assessing the utility of machine learning applications. The computational approach undertaken here evaluates the accuracy of convolutional neural networks (CNNs) designed to estimate age-at-death based on evaluation of digital 3D models of the pubic symphyseal face. CNNs are machine learning systems that have demonstrated success in image processing and computer-aided diagnostics wherein they take advantage of structured, local relationships within the data to produce accurate categorization of images.

The topographic morphology of the symphyseal face of 232 male individuals of known age-at-death was digitally rendered using a laser scanner. This data set was provided to the CNN for training purposes. An independent test set, representing ages from 18 - 91 years old at time of death, was offered to the CNN for evaluation and achieved a mean error of +/- 17 years. Initial results indicate that CNNs may be useful in establishing age-at-death of geriatric individuals who tend to be under-aged using traditional methods. Further research will allow for identification of an ideal training sample size for high accuracy output using learning curve methodological approaches which will help to define the feasibility of machine learning applications to forensic skeletal analysis.

Replication and extension: Handedness in termite-fishing among Gombe chimpanzees

EMMA T. BRZEZINSKI[1], NICOLE M. SCHAPKER[1], MATTHEW FERRY[2], LINDA F. MARCHANT[1] and ROBERT C. O'MALLEY[3]

[1]Department of Anthropology, Miami University, [2]The National Museum of Natural History, The Smithsonian Institution, [3]The Center for the Advanced Study of Human Paleobiology, The George Washington University

Study of termite-fishing among chimpanzees in Gombe National Park, Tanzania, is now in its sixth decade since the tool use pattern was first reported by Goodall in 1963. This form of habitual, learned, and skilled tool-use is typically performed with one hand and has been the focus of multiple studies to characterize the pattern of lateral hand preferences in these apes. Marchant and McGrew have suggested that *Pan troglodytes* provides an intermediate model of manual lateralization between *Homo sapiens* and the rest of the living primates. Here we scrutinize and extend two prior studies (McGrew and Marchant 1996 and O'Malley et al., 2017) to provide temporal windows into subjects' performance.

The data come from 50 subject, 22 males and 28 females, who were community members from the early 1990s through 2008-2009. Six individuals are represented in both time windows; five maintained their lateral preference and one shifted to ambidexterity when termite fishing observations are scored as "events" – each insertion of a tool was scored as a data point (prop. test function in R, single-sample, two sided, $p<0.05$). Overall, 31 of the 50 individuals are lateralized ($p<0.5$), and of these, 20 are wholly lateralized: *exclusively* left- or right-handed in termite-fishing. Fifteen are left preferent and 5 are right preferent. In the 2008-2009 study, 10 of 20 subjects occur in both samples and 7 of the 10 maintained their lateral preference. We evaluate scoring methods in these two studies, and assess the claims for population-level handedness in this population of chimpanzees.

Climate, craniofacial plasticity and culture: A comparison of ecogeographic patterns in cranial shape between Jomon foragers and Japanese macaques

LAURA T. BUCK[1,2], ISABELLE DE GROOTE[3], YUZURU HAMADA[4] and JAY T. STOCK[1,5]

[1]Department of Archaeology, University of Cambridge, [2]Department of Earth Sciences, Natural History Museum (London), [3]School of Natural Sciences and Psychology, Liverpool John Moores University, [4]Section of Evolutionary Morphology, Primate Research Institute, Kyoto University, [5]Department of Anthropology, Western University, London, Ontario

Extensive phenotypic variation in humans may reflect plastic responses to global distribution. Could relatively malleable size/shape have been important to *Homo* adapting to novel climates? We seek to establish a base-line for human skeletal climatic adaptation by comparing *H. sapiens* to a non-human primate (NHP) outgroup. We analysed craniofacial shape differences between groups of Japanese macaques (*Macaca fuscata*) and between groups of Japanese prehistoric foragers (Jomon) from different latitudes. *M. fuscata* have amongst the greatest latitudinal spread of any NHP and overlap in habitat with the Jomon. Climatic variation in cranial shape has been reported within *M. fuscata* and the Jomon, but systematic exploration is lacking. We analysed craniofacial shape using geometric morphometric methods on Jomon from 5 latitudes and *M. fuscata* from 4 latitudes throughout the Japanese Archipelago (macaques are not found on Hokkaido in the far North). There is ecogeographic patterning in shape in the macaque sample and some significant differences between macaque groups. When modelled, shape differences mirror cold-adaptation in humans. More northerly groups show shorter, broader faces, larger orbits, narrower noses and larger neurocrania. There is no clear ecogeographic pattern within the Jomon and no significant differences in shape between groups. Climate is known to affect human cranial shape only at extreme latitudes. A climatic gradient sufficient to impact macaque cranial morphology could have been mediated by Jomon culture, protecting the phenotype from costly adaptation. This may emphasise the importance of cultural/behavioural plasticity in human colonisation, or show differences in threshold for phenotypic plasticity between species.

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Examining the effects of early-life stress on mortality at Himera by analysis of enamel defects

SIMON A. BULL[1], BRITNEY KYLE[2], LAURIE REITSEMA[3], DANIEL H. TEMPLE[1], PIER FRANCESCO FABBRI[4] and STEFANO VASSALLO[5]

[1]Department of Sociology and Anthropology, George Mason University, [2]Department of Anthropology, University of Northern Colorado, [3]Department of Anthropology, University of Georgia, [4]Department of Cultural Heritage, Università del Salento, [5]Archaeological Heritage Section, Archaeological Superintendency of Palermo

This research explores the expression of linear enamel hypoplasia (LEH) and its association with mortality in a cemetery sample from Himera, Sicily (7^{th}-5^{th} century BCE). Remains (n=309) were examined macroscopically and scored for presence of LEH in accordance with the Global

History of Health Project's Data Collection Codebook. Microscopic analysis of LEH was then performed on a subset of these individuals (n=20). Chi-square statistical tests were used to evaluate differences in presence of LEH by variables of sex, age, and burial style. Hazards analysis was then used on microscopic data to test the hypothesis that age-at-first-defect formation significantly increases mortality risk. Chi-square analysis revealed no significant differences in prevalence of LEH by sex ($p < 0.12$), age ($p < 0.07$), or burial style ($p < 0.22$). For microscopic data, hazards analysis found that age-at-first-defect formation does not accentuate the risk of death in these samples (Wald=0.127, p=0.721). Individuals with varying frequencies and periodicities of LEH share an equal risk of mortality at Himera. Such findings suggest that there may have been environmental and social contexts that helped to provide resiliency to individuals after surviving a stressful event. Since Himera represented a rich cultural and ethnic milieu, there are many variables that may have interacted and mediated responses to early life stressors. Specifically at Himera, we suggest that further research be done to investigate whether social and economic status of differing groups contributed to an individual's ability to respond to early life stress.

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Development of a taxonomically dense genomic database of anthropoid primate genomes

ANDREW S. BURRELL[1], MAREIKE C. JANIAK[2], TODD R. DISOTELL[1] and CHRISTINA M. BERGEY[3]

[1]CSHO, Anthropology, New York University, [2]Anthropology, Rutgers University, [3]Anthropology and Biology, The Pennsylvania State University

Taxonomically dense sets of genome assemblies allow insights into many aspects of primate evolution, from phylogeny and the timing of divergences within the primate tree to genome organization and the identification of clade-specific functional elements outside of coding regions.

In order to assemble the most comprehensive genomic dataset of primates to date, we have sequenced over a dozen anthropoid genomes with two strategies: Illumina short read-only assemblies to 30x read depth (including *Cebuella*, *Chiropotes*, *Leontopithecus*, *Pithecia*, *Saimiri*, *Nasalis*, *Presbytis*, *Semnopithecus*, *Lophocebus*, and *Mandrillus*) and 10X Genomics' Chromium Genome single-molecule sequencing for several taxa in key phylogenetic positions (including *Trachypithecus*, *Alouatta*, and *Sapajus*). The Chromium assemblies were of high quality, with scaffold N50s between 3.0 and 9.6 Mb, contig N50s of >50kb, and assembly sizes >2.5Gb using only scaffolds larger than 10kb. These are comparable to publicly available assemblies such as *Rhinopithecus* and *Papio*. We did notice a correlation between the starting amount of high molecular weight (HMW) DNA used for the Chromium preparation and the quality of the resulting assembly, with HMW DNA amounts of >2ng yielding considerably better assemblies (scaffold N50 ~ 10Mb) than those with <1ng (scaffold N50 ~3Mb). Unlike other approaches, the Chromium genome assemblies can generate long blocks of sequence from the Y chromosome. Contigs from *Sapajus* aligning to the *Homo*Y chromosome ranged from <10kb to over 4.5 Mb. Difficult to sequence multicopy genes, such as TSPY, were recovered easily. We aim to add a further ~20 genomes to our dataset.

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An ancient form of Paget's Disease at Norton Priory, UK

CARLA L. BURRELL[1], SILVIA GONZALEZ[1], ROBERT LAYFIELD[2], LYNN SMITH[3] and JOEL D. IRISH[1]

[1]Research Centre for Evolutionary Anthropology and Palaeoecology, Liverpool John Moores University, [2]Faculty of Medicine and Health Sciences, The University of Nottingham, [3]Norton Priory Museum and Gardens, Cheshire

Paget's disease is a chronic metabolic disorder affecting normal bone turnover. This disease typically affects the axial skeleton leading to enlarged and weakened bone. It is often recorded in males over 55 and occasionally, further complications such as pathological fracture and deformity are reported. There appears to be a regional concentration in the northwest of England, although the prevalence of this disease is high within the UK in comparison to other countries.

Previously, six skeletons were identified with a Paget's-like disorder within the Medieval Norton Priory Collection, Cheshire, UK (n=130). Here, an additional 12 skeletons have been subjected to full macroscopic and radiological review and similar characteristic lesions of this disease have been identified presenting a new population prevalence of 13.8%. Additional radiocarbon dating and stable isotopic analysis (C, N and Sr) have identified that this ancient disease was evident throughout this site's usage and all individuals originated from the northwest of England with a marine based diet.

Although the lesions are characteristic of Paget's disease the etiology is a somewhat different. Males dominate this sample but, age-at-death estimations start at 35 years with over 50% of their skeletons affected with this disorder. Typically, in modern populations only one or a few bones are affected in individuals over 55 years of age. Preliminary molecular analyses of the remains suggest the disease at Norton Priory may have been an ancient precursor of modern day Paget's disease, providing new insight to the atypical etiology observed at the site.

I wish to thank the Paget's Association for their Research Grant and extensive support on this project.

A divided issue: Investigating internal structure differences of crania with *os japonicum*

LAUREN N. BUTARIC[1], SCOTT D. MADDUX[2], MATTHEW KESTERKE[3], QIAN WANG[3], QUN ZHANG[4] and QUANCHAO ZHANG[4]

[1]Department of Anatomy, Des Moines University College of Medicine, [2]Center for Anatomical Sciences, University of North Texas Health Science Center, [3]Department of Biomedical Sciences, Texas A&M College of Dentistry, [4]Department of Archaeology, Jilin University

Among modern humans, the *os japonicum* (bipartite/divided zygomatic bones) is known tooccur in higher frequencies in populations of Asian descent. However, relationships between divided zygomas and the surrounding external, and, particularly, internal structures largely remain unexplored. Using cone-beam computed tomographic (CBCT) scans of northern Chinese/Mongolian samples, we compare external and internal morphology of mixed-sexed individuals with divided (n=11) and normal (n=15) zygomas. A total of 30 landmarks were placed on digitally rendered crania and subjected to Generalized Procrustes analysis; centroid sizes were also obtained for the full-configuration of landmarks and for the maxillary sinus specifically. When comparing divided versus normal zygoma, t-tests indicate no significant differences in sinus size (t=-0.793; p=0.439). Principal components analysis indicates PC1 (21.62% of the variance) mainly contrasts variation in maxillary sinus size relative to the overall facial skeleton, with no discernable separation between individuals with divided/normal zygomas or between the sexes. However, PC2 (14.24%) indicates separation with divided zygomas (positive PC2-axis) presenting overall taller zygomaxillary sutures and medially-laterally wider sinuses that are more superiorly-situated within the face, compared to individuals with normal zygomas (negative PC2-axis). T-tests confirm these differences along PC2 are significant (t=4.915; p<0.0001). Reduced major axis regression analyses indicate that allometry does not account for variation along PC1 (slope=-1.051; R^2=0.101; p=0.114) or PC2 (slope=-0.8528; R^2=0.111; p=0.0959). Thus, while individuals with divided and normal zygomas do not differ in the overall size of their maxillary sinuses, their sinuses do exhibit significant differences in the overall shape, with potentially important biomechanical implications.

Enamel thickness variation in human molars and its importance for the practice of interproximal reduction

LAURA BUTI[1], KEVIN M. REILLY[2], ADAM D. SYLVESTER[3], STEFANO BENAZZI[1,4] and ROBIN N.M. FEENEY[2]

[1]Department of Cultural Heritage, University of Bologna, [2]School of Medicine, Health Sciences Centre, University College Dublin, [3]Center for Functional Anatomy and Evolution, The Johns Hopkins University School of Medicine, [4]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology

Interproximal reduction (IRP) is widely used as a preventative and therapeutic measure for dental crowding. The amount of tissue that can be safely removed depends on accurate reference data, which are often unavailable or imprecise. We measured interproximal enamel thickness from virtual 2D sections recorded for 75 permanent molars from microtomographic data to investigate thickness differences: 1) between molar positions, 2) within and between quadrants of the crown, 3) along the height of the crown. Interproximal thickness values within and between molar positions were analysed using non-parametric Friedman test and Friedman posthoc analysis.

Patterns in the morphological distribution of enamel thickness largely coincided with previous reports, however results were disparate in the cervical interproximal region of the crown. Most of the significant variation in enamel thickness was found in the occlusal slope of the crown, which is likely due to the arrangement of the working and guiding cusps on maxillary and mandibular molars. Moreover, the greatest variation between molar positions was found in the distal interproximal region of the crown, likely due to the variable presence and degree of expression of the hypocone and hypoconulid cusps.

It is recommended that practitioners of IPR adhere to the current norm of "conservative" enamel removal, with further refinement through selection of the most appropriate location (average thickness) for additional tissue removal within a molar crown and between molar positions. Our local crown specific thickness data may be used as guidelines for consultation by dental practitioners performing IPR and for dental researchers alike.

Genetic Ancestry, Race, and National Belonging in Argentina: Mid-Study Results

GRACIELA S. CABANA[1], MARCELA MENDOZA[2] and LINDSAY SMITH[3]

[1]Department of Anthropology, University of Tennessee, Knoxville, [2]Department of Anthropology, University of Eugene, Oregon, [3]Department of Geography & Environmental Studies, University of New Mexico

Social science and bioethics scholars have raised the question of whether genetic ancestry-based studies encourage a new form of race essentialism. To develop a better understanding of the dynamic between genetics and race, we are investigating how genetic ancestry inference (GAI) affects notions of racial and ethnic identity, as well as national belonging in Argentina.

Here we present midterm study results based on ethnographic interviews with 80 participants from the city of Luján, Province of Buenos Aires. Thus far we have interviewed participants twice (prior to, and immediately after, receiving personal GAI tests). Participants have tended to focus on data confirming known familial oral history, while at the same time have been less interested in discussing data associated with non-European populations. This is contrary to many US-based results, in which test-takers often show greater interest in minority identities associated with their GAI results. Moreover, most of our participants claimed being unmoved or unchanged by their personal GAI results, but did occasionally assert feeling either more "Argentine" or more "cosmopolitan" if their GAI results were associated with indigenous American samples.

Arguably, these outcomes may reflect two decades' worth of national efforts toward "pluriculturalism," the main focus of which has been to legitimize indigenous peoples in Argentina (rather than about welcoming immigrants from border or other countries, for example). Thus, the relative social value of minority identities within a country may shape the way in which participants value unexpected results.

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A probable case of extradural meningioma in a twentieth-century cranium from the Francisc I. Rainer Anthropological Collection in Bucharest, Romania

SHANNON E. CALDWELL[1], THOMAS A. CRIST[2] and MIHAI CONSTANTINESCU[3]

[1]Anthropology, University of Wisconsin-Madison, [2]Programs in Physical Therapy and Sociology/ Anthropology, Utica College, [3]"Francis. I Rainer" Institute of Anthropology, Romanian Academy, Bucharest

Historical anatomical collections are essential for the accurate diagnosis of uncommon skeletal lesions. We report on the differential diagnosis of a lesion found on the cranium of a 35-45-year-old woman as a probable meningioma. Obtained during the mid-twentieth century for Dr. Francisc I. Rainer's anatomical collection at the University of Bucharest, the cranium presents a raised, circular lesion located primarily on the frontal and extending onto the parietals, subsuming bregma. Measuring 55 mm A/P and 54 mm transversely, the lesion is characterized by moderate, active porosity and discoloration within its well-defined border. According to the clinical literature, between 15 and 20% of intracranial neoplasms are diagnosed as meningiomas. These neoplasms originate as soft tissue tumors formed from the arachnoid cells associated with the dura mater located near the spinal cord and brain. The differential diagnosis of the lesion on the Romanian cranium includes consideration of hemangioma, osteoma, osteosarcoma, metastatic tumor, fibro-osseous lesions, and meningioma. Based on the sex and age of the individual, the location and appearance of the lesion, and similarity to the limited number of previously described paleopathological cases, the lesion most likely represents the infrequently observed extradural type of meningioma.

Quantifying sexual dimorphism in the geometry of modern human canines

GRACE V. CALHOUN, DEBBIE GUATELLI-STEINBERG and MARK HUBBE

Anthropology, The Ohio State University

Over human evolutionary history, canine teeth evolved from a form with a more acute cusp angle to one which is less acute, and thus more rounded. While there have been many studies that quantify sexual dimorphism in the size of modern human canines, the degree of sexual dimorphism in their shape is not clear. We sought to explore in what ways modern human male and female canines differ in their shape, and specifically whether males have a more pointed canine shape than females. 204 unworn or minimally worn canines (112 males, 92 females) were measured from dental casts of Gullah individuals. Angles at the canine cusp tip were calculated from crown measurements, and then compared between sexes. T-tests show that females have on average slightly more rounded canines (by about 10 degrees) in all four tooth types ($p<0.001$ for URC, ULC, and LRC; $p=0.003$ for LLC). To scale these differences to crown size, we calculated ratios between crown angle and crown height, and between mesial and distal occlusal edge lengths to crown height. Crown angle to crown height ratios were larger for females than for males ($p<.001$); mesial edge length to crown height ratios were larger for males than for females ($p<.001$); and, distal edge length to crown height ratios were larger for males than for females ($p=0.015$). These results suggest that the canine tooth, which is the most sexually dimorphic tooth in the dental arcade in terms of size, also exhibits sexual dimorphism in terms of shape.

Cribra orbitalia in correlation with craniofacial asymmetry in the children from the DeLiefde cemetery in Amsterdam; an investigation of orbital variations in relation to malnutrition and disease

KRISTA A. CALVO[1], CHRISTOPHER C. GILBERT[2] and LIESBETH E. SMITS[3]

[1]Anthropology, Hunter College, [2]Anthropology, Hunter College, [3]Amsterdam Centre of Ancient Studies and Archaeology, University of Amsterdam

Cribra orbitalia is one of the most frequent pathological lesions seen in ancient and historic human skeletal remains. The biological causes of this abnormality have been debated, but they are almost always linked to malnutrition and disease. The purpose of this project is to determine if cribra orbitalia also correlates with craniofacial fluctuating asymmetry in the orbital region of afflicted children. To investigate this relationship, data was collected on afflicted children from the University of Amsterdam's DeLiefde osteological collection as well as unafflicted children from the osteological collections at The American Museum of Natural History. Using sliding calipers, measurements of orbital breadth and height were taken on only females or probable females to control for sex. Asymmetry was calculated as a ratio of left and right orbit shapes, and cribra development was scored qualitatively on a 4 point scale. A non-parametric correlation did not detect a significant relationship between orbit asymmetry and cribra development, and a one-way ANOVA did not detect any significant differences in asymmetry among cribra scoring categories either. Thus, our results suggest that there is not enough evidence to confidently state that cribra orbitalia causes asymmetry in the orbital regions of the children in these collections. Other measurements of asymmetry, in addition to simple orbit shape ratios, should also be investigated in the future. This work is important as it contributes to current investigations into the bioarchaeology of children, a developing subject of research.

Does dietary variation correlate with brachial and crural index variation in Holocene southern Africa?

MICHELLE E. CAMERON

Department of Anthropology, University of Toronto, PAVE Research Group, Department of Archaeology, University of Cambridge

Southern African Later Stone Age (LSA) body size variability has been associated with changes in population density. Dietary composition, as indicated by carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotopes, inconsistently correlates with LSA body size variability. Intrapopulation variation in LSA limb proportions (i.e. ratios between proximal and distal limb element lengths) has received less attention. Limb proportionality is often debated in human evolutionary research as it may be affected by climate. However, limb proportions may additionally reflect environmental stressors experienced during growth and development, including nutritional insufficiency. LSA groups from the Mediterranean-type Cape coast and the semiarid central interior consumed different types of foods due to ecological and subsistence strategy variation between these regions. Differential resource availability may have impacted the growth and development of particularly distal limb segments with implications for adult limb proportions. This paper tests if dietary composition, as indicated by $\delta^{13}C$ and $\delta^{15}N$ stable isotopes, influenced LSA southern African limb proportions among Cape coast (n=73) and central interior (n=38) groups.

Maximum humerus, radius, femur, and tibia lengths were used to calculate brachial (radius/humerus) and crural (tibia/femur) indices. Pearson correlation coefficients were used to assess the direction and strength of relationships between these indices and $\delta^{13}C$ and $\delta^{15}N$ ratios. Central interior crural indices correlated positively with $\delta^{15}N$ values ($p=0.016$), indicating greater tibia lengths relative to femur lengths with the consumption of higher trophic level foods. The consumption of higher trophic level foods in the unpredictable central interior may have positively impacted growth and development in this region.

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Sternum maturation in an identified Portuguese skeletal sample

VANESSA CAMPANACHO[1,2], HUGO FV. CARDOSO[3] and ANDREW T. CHAMBERLAIN[4]

[1]CIAS - Research Centre for Anthropology and Health, University of Coimbra, [2]CEF - Centre for Functional Ecology - Group of Paleoecology and Forensic Sciences, University of Coimbra, [3]Department of Archaeology and Centre for Forensic Sciences, Simon Fraser University, [4]School of Earth and Environmental Sciences, University of Manchester

Estimation of age at death is one of the fundamental parameters that needs to be established when analyzing skeletal remains. The degree of skeletal and dental maturity can be quantified in order to estimate the age of death in juvenile individuals. However, the maturation timing of the primary and secondary ossification centers of the sternum has received little if any attention in dry bone specimens compared to other skeletal elements. The research aim was to document the age of maturation events in sternal elements of 68 individuals from both sexes, belonging to the identified skeletal collection that is housed at the National Museum of Natural History and Science in Lisbon, Portugal. A three stage classification of unfused, partial, and complete fusion was implemented to record the fusion between the sternebrae and at the clavicular and intercostal notches. Analysis was performed only on the sample of pooled sexes due to the small sample size. Body sternebrae fused between the ages of 1 and 27, with the fusion between the first and second sternebra initiating and completing at later ages. Clavicular and intercostal notches fuse between 5 and 25 years of age. The sternal primary and secondary ossification centers exhibit wide age ranges of fusion, implying greater variability in the timing when compared to fusion in other skeletal elements. The variable timing of fusion between sternal elements may be associated with the variable number of ossification centers per sternebra, and indicates that sternal maturation has little use for age estimation.

Burial Patterning and Biological Distance at the Black Earth Site (11-Sa-87): Implications for Understanding Cemetery Development During the late Middle Archaic

MEADOW L. CAMPBELL[1] and RYAN M. CAMPBELL[2]

[1]Basic Science, Logan College of Chiropractic, [2]Center for Archaeological Investigations, Southern Illinois University Carbondale

The Black Earth Site (11-Sa-87) in Saline County, Illinois is an important bioarchaeological resource with a significant late Middle Archaic component. The site's large cemetery presents a unique opportunity to explore how early populations in the Mid-South interacted with the landscape to construct ritual space. The site represents a semi-permanent occupation of the Saline Valley used by small groups during seasonal aggregations. It is unclear whether the people who inhabited the Black Earth Site maintained a permanent cemetery with kin buried in proximity to one another, or if the cemetery represents a random assortment of burials placed as groups returned to the location periodically. To examine potential clustering of kin groups within the cemetery, we compared burial proximity to biological distance to determine if like individuals were found within the same areas of the cemetery. Burial proximity was quantified by calculating the Euclidean distance between burials from coordinates captured in QGIS. The Mahalanobis D calculation based on both dental and cranial traits was employed as our measure of biological distance. The two distance matrices were compared using the Mantel test. Our results indicate that no significant correlation exists between biological distance and burial proximity. While recognizing the limitations inherent in attempting to identify kin groups using skeletal data, we suggest the results are consistent with what would be expected at a site that was seasonally occupied without the maintenance of formal cemetery boundaries.

Earthly and Eternal: The Poetics of Violence in Ancient Egypt

ROSELYN A. CAMPBELL

Cotsen Institute of Archaeology, UCLA, Paleo-oncology Research Organization, PRO

Anthropological studies of violent behavior over the past few decades have suggested that carefully staged performance of violent acts may be used to force or reinforce ideology and group identity in cultures throughout time and history. In ancient Egypt, violence was regularly depicted in art to demonstrate the king's dominance over defeated enemies. Many have assumed that such depictions of state-sanctioned violence were purely symbolic, but there is evidence to suggest that ritualized killing did take place in ancient Egypt.

This paper assesses depictions of violence and human remains that appear to have been victims of such violent performances in ancient Egypt, particularly execution and human sacrifice. The results of this analysis suggest that different types of violence were used for different circumstances. Some methods of lethal violence were meted out to immediately punish a victim for a real or perceived transgression, while other forms of violence seem to have been specifically designed to continue punishment into the afterlife. In a culture that placed heavy emphasis on the afterlife, eternal punishment could be ensured by dismembering or destroying the body of the deceased, effectively precluding the deceased from entering the afterlife. Some forms of violence do not seem to have been intended as punishment at all, but rather were viewed as part of a funerary ritual. This study examines the context, motivation, and performance of these different types of violence in an attempt to understand how these violent performances were used to fulfill, maintain, and enforce ideological and social roles.

Specimen dates and species longevity: An evaluation of the use of temporal range data for questions of ancestry in the hominin fossil record

TIMOTHY L. CAMPBELL[1], CHRIS ROBINSON[2], SUSANNE COTE[3] and DARRYL J. DE RUITER[1]

[1]Department of Anthropology, Texas A&M University, [2]Department of Biological Sciences, Bronx Community College, [3]Department of Anthropology and Archaeology, University of Calgary

Utilizing *Australopithecus sediba* as a case study, we evaluate statements implying that this taxon cannot be ancestral to *Homo* as the specimens from Malapa are found later in time (~1.98 Ma) than the earliest proposed examples of our genus (~2.8–2.4 Ma). For hypotheses about the ancestral nature of *A. sediba* to be plausible, two things must be established. First, it must be possible for ancestral and descendant taxa to coexist. Under a budding cladogenesis model of speciation a subset of a species differentiates into a new daughter taxon while the remainder of the species maintains cohesion. Among mammals, contemporaneous ancestral and descendant taxa are reported in the literature, ranging from rodents to proboscideans. Second, the amount of time represented by a "ghost lineage" must be reasonable. Many studies that have estimated the average mammal species duration have values ranging between 2-4 Ma, although these estimates are dependent on the dataset used and the taxonomic group. Utilizing published temporal range data of fossil hominin species, and incorporating proposed dating error, we calculate a conservative average hominin species temporal range of ~0.97 Myr. Using this estimate in a thought experiment wherein Malapa represents the first appearance date (FAD), midrange date, or last appearance date of the species, possible FAD's for *A. sediba* range from 2.95–1.98 Ma. As these scenarios are all equally plausible, there is no *a priori* reason that *A. sediba* could not be ancestral to *Homo* based solely on the dates of the specimens currently known.

Microbiome variability associated with age, sex, and social group in *Gorilla beringei*

EMMA C. CANCELLIERE[1,2], JESSICA M. ROTHMAN[1,2,3] and ANDRES M. GOMEZ[4]

[1]Department of Anthropology, CUNY Graduate Center, [2]New York Consortium of Evolutionary Anthropology, New York Consortium of Evolutionary Anthropology, [3]Department of Anthropology Anthropology, Hunter College, [4]Department of Animal Science, University of Minnesota

The primate gut microbiome is a dynamic system, capable of rapid turnover and change in response to intrinsic and extrinsic factors. Across gorilla species, gut microbial communities are modulated in part by degree of folivory. However, less is understood regarding within-species variation in the gastrointestinal microbiome. Based on 47 fecal samples collected in June 2013, we examine the effect of age, sex, and social group on compositional variation in the gastrointestinal microbiome of mountain gorillas (*Gorilla beringei*). Gut microbiome alpha-diversity does not differ by sex (Kruskal-Wallis, $F=11.51$, $p=0.81$), but does with age (Kruskal-Wallis, $F=3.96$, $p=0.04$). Social group holds the strongest relationship with microbiome alpha-diversity (Kruskal-Wallis, $F=24.838$, $p<0.001$). Beta-diversity based on Bray-Curtis dissimilarity differed across social group and sex, and demonstrated a clear tendency across age classes (PERMANOVA, Social group: $R^2=0.29402$, $p=0.001$; Sex: $R^2=0.67$, $p=0.03$; Age: $R^2=0.08713$, $p=0.054$). Our results demonstrate within-species compositional variation in the gut microbiome of *Gorilla beringei*. Differences in social group complement findings from baboons and chimpanzees, where reciprocal social interaction leads to microbiome homogeneity within groups. Differences across ages may reflect turnover during ontogeny associated diet and development of the gastrointestinal tract; given the high reliance on herbaceous foods in *G. beringei,* this trend may be heightened compared to frugivorous primates. Lastly, sex differences in beta-diversity may indicate sex-specific nutritional strategies related to size sexual dimorphism. Further inquiry into individual behavior and diet will help us understand how these compositional differences impact the life history, social relationships, and diet of *Gorilla beringei*.

Examining long-term trends in primate abundance in Korup National Park, South West, Cameroon

T A. CAPEL[1], E HALL[2] and C A. JOST ROBINSON[1,2]

[1]Anthropology, University of North Carolina Wilmington, [2]Anthropology, Purdue University

Rapid expansion of wildlife economies and extractive industries in Afrotropical forest zones make longitudinal ecological datasets critical to the effectiveness of non-human primate conservation. Similarly, the fast pace required to mitigate the potential extirpation of species is not always compatible with the development / implementation of long-term monitoring. This study provides a 24-year comparison of non-human primate abundance and community composition in northeast Korup National Park (KNP), South West, Cameroon. Ecological line transect data (n = 59.2km) collected in 2014 are compared to previous surveys (1990, 2004/2005), allowing for robust analysis of NHP nonhuman primate assemblages in KNP. Our data indicate non-significant variation in primate encounter rates across years. However, examination of community composition chronicles a complex history of nonhuman primate populations, likely due to regional hunting practices. In 2004-2005 *Cercopithecus nictitans* (putty nose monkey) accounted for nearly half of all observations (48.6%), dropping to 36% in 2014. Given their large body size, it is possible that *C. nicitians* has become a target for hunters. This is coupled with an increase in encounters (2004/2005: 0.05 individual/km vs. 2014: 0.11 individual/km) and representation (11.4% to 24%) of *Cercopithecus erythrotis* (red-eared guenon) between 2004-2005 and 2014. We hypothesize this relates to maintenance of local taboos regarding consumption of *C. erythrotis*. Our data contribute to regional understandings of nonhuman primates in relation to hunting and human pressures. We also demonstrate the importance of long-term field sites to conservation, as they reveal more

accurate assessments of population trends not observed in shorter studies.

College of Arts and Science, University of North Carolina Wilmington, Primate Conservation Inc.

The mother/infant dyad: Investigating inherited health through incremental dentine analysis and bacterial bioerosion

ARIANNE CAPIRCI[1], REBECCA GOWLAND[1], CLAIRE HODSON[1], TOM BOOTH[2] and JANET MONTGOMERY[1]

[1]Department of Archaeology, Durham University, [2]Vertebrates and Anthropology Palaeobiology, Department of Earth Sciences, Natural History Museum

The Developmental Origins of Health and Disease (DOHaD) hypothesis has highlighted the importance of the first 1000 days of life for longer term health. The mother/infant dyad has tended to be neglected in bioarchaeological studies, yet the skeletal remains of infants can provide important insights into maternal health. A multidisciplinary analysis of 12 perinatal individuals from the Iron Age/Roman site of Piddington, Northhamptonshire, England, was undertaken with the aim of assessing maternal health and perinatal mortality. High resolution stable isotope analysis of carbon and nitrogen was undertaken on perinatal tooth dentine from various teeth to assess intra-uterine values and evidence for maternal stress via elevated $\delta^{15}N$ values. Micro-CT analysis of bacterial bioerosion in perinatal femora provided unique insights into the likelihood that infants were stillborn or died after their first feed due to diagenetic signatures related to infant gut colonization. Finally, palaeopathological assessment using traditional macroscopic methods was also undertaken.

High fetal $\delta^{15}N$ values were observed throughout the duration of tooth formation *in utero*, which has been interpreted as a physiological stress response. Overall, the palaeopathological evidence, isotope values, and bacterial bioerosion reveal that those with the highest $\delta^{15}N$ values were more likely to be free from bacterial bioerosion than those with lower $\delta^{15}N$. This is to be expected in that individuals showing signs of 'stress' were more likely to have increased mortality prior to or during birth. In sum, multifaceted analysis of perinatal skeletal remains has the potential to highlight maternal and infant stress in the past.

Are Social Inequalities Embodied as Growth Disparities in Children?

HUGO FV. CARDOSO[1], LESLEY HARRINGTON[2], JENNIFER NELSON[2,3], EMILY HOLLAND[3], VIOLA TANGANELLI[4] and MARIA GIOVANNA BELCASTRO[4]

[1]Department of Archaeology, Simon Fraser University, [2]Department of Anthropology, University of Alberta, [3]Department of Anthropology, Brandon University, [4]Department of Biological, Geological and Environmental Sciences, University of Bologna

Amassing of skeletal reference collections has resulted in the overrepresentation of societies' impoverished. The study of biological expressions of social conditions provides the opportunity to explore the biological dimensions of power relations and to give voice to the voiceless. This study examines growth disparities in children from two such collections derived from 20th century cemeteries (Lisbon, Portugal and Bologna, Italy). Diaphyseal length measurements of the long bones were taken from known sex and age juveniles (Lisbon n=77, Bologna n=70), aged between birth and 12 years. Age and sex-specific z-scores for bone length were calculated for each individual using Maresh reference data. Sample mean z-scores were then compared. Children in both collections show a significant growth deficit relative to the reference, with the femur showing the largest deficit (mean z-score = -2.13), while the radius (-1.14) showed the least. The Bologna children are significantly ($p<0.01$) more retarded in linear growth than the Lisbon children. These growth differentials may result from social inequalities in death, which affect burial practices and incorporation into collections. Although both collections incorporate unclaimed cemetery remains, in the Bologna collection the process may have resulted in a greater representation of the most impoverished. Conversely, growth differentials may also reflect social inequalities experienced during life, reflecting different social backgrounds and pathways to industrialization, and the social disparities it created. The rich sample contexts and growth's responsiveness to social circumstances, provides an ideal source of information to study embodiment that can expand our knowledge of social inequalities in past populations.

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Modelling variability in limb loading during simulated arboreal locomotion: an experimental approach

KRISTIAN J. CARLSON

Department of Integrative Anatomical Sciences, University of Southern California, Evolutionary Studies Institute, University of the Witwatersrand

Arboreal habitats are often distinguished from terrestrial habitats by having greater substrate dimensionality and discontinuity. While traversing arboreal habitats, typically limbs of an organism are presumed to experience comparatively more diverse loading. Modeling naturalistic substrate complexity in controlled laboratory settings is difficult, limiting quantification of load variability. To further explore this variability, different limb kinematics were elicited from lemurids (*Eulemur rubriventer*), emphasizing the frontal plane, during quadrupedalism on simulated arboreal supports and external bending moments experienced by the forearm and leg were quantified. Predictions that locomotion in an arboreal habitat is characterized by comparatively greater and more varied external bending moments were tested.

Substrate reaction forces and kinematics for 390 limb contacts were collected. Individuals traveled along a wooden runway, a linear pole with a central instrumented section, or the same pole with the instrumented section laterally offset from the remainder of the pole at set increments. The offsets elicited limb contacts with different kinematics (e.g., shoulder and hip adduction) than the wooden runway or linear pole. As the offset section was moved laterally, shoulder and hip adduction usually decreased while angles of the frontal plane resultant force vector usually increased, even at times exceeding angles observed during runway or linear pole contacts. Hind limb contacts were regularly associated with higher resultant force vector angles. Discrepancies between forearm or leg angles versus resultant force vector angles were evaluated at peak vertical and horizontal forces to compare external bending moments. Results extend the documented range of variability in limb loading.

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Traditional and industrial food preservation agents shape the gut microbiota

RACHEL N. CARMODY and LAURA D. SCHELL

Department of Human Evolutionary Biology, Harvard University

Many traditional and industrial dietary additives exhibit robust antimicrobial activity against foodborne pathogens, contain chemical structures accessible exclusively to select microbial enzymes, or otherwise alter environmental conditions known to favor specific microbial taxa *in vitro*. Consumption of these compounds might therefore be expected to perturb competitive dynamics among the trillions of microbes inhabiting the human gut, altering critical microbial contributions to nutrient digestion and energy regulation. Here, we explore how consumption of traditional and industrial food preservatives shapes the gut microbiota and its contributions to host energy gain. We screened common traditional and industrial preservatives *in vitro* for dose-dependent effects across a panel of human gut isolates and whole fecal communities cultured under anaerobic conditions. We advanced two traditional preservatives (vinegar and garlic) and two industrial preservatives (EDTA and BHA) to *in vivo* testing in C57BL/6J mice exposed to diet-relevant doses for four weeks via gavage or water supply. Surveying the gut microbiota by growth dynamics, 16S rDNA sequencing, qPCR and RT-qPCR offers early indication that

dietary preservatives can retain their antimicrobial effects within the gut lumen, altering gut microbial structure and function. Follow-up studies involving transplants of conditioned gut microbial communities into gnotobiotic hosts will isolate the impact of preservative-induced changes in the gut microbiota on host energy metabolism. Our preliminary results underscore the importance of considering microbial contributions to human energy budgets in the past and present, and support the possibility that non-caloric dietary components have caloric consequences for humans mediated through their effects on the gut microbiome.

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Variation in time to weaning in wild geladas

SOFIA C. CARRERA[1] and JACINTA C. BEEHNER[1,2]

[1]Psychology, University of Michigan, [2]Anthropology, University of Michigan

Given the high cost of lactation, mothers should wean their offspring as soon as they reach nutritional independence. But, what factors cause infants to reach this stage earlier or later? Time to weaning is influenced by characteristics of both the mother (e.g., parity) and the infant (e.g., sex, season of birth). Here, we look for a signature for early or late weaning using these variables in a wild population of geladas (*Theropithecus gelada*). We predicted that earlier weaning would occur for male infants, multiparous mothers, and infants born during the "birth season". We analyzed weaning data (based on resumption of sexual swellings) from 56 mother-infant pairs. Time to weaning was our outcome variable, and mother's parity, infant sex, and season of birth created groups to perform Wilcoxon rank sum tests. We found that males were weaned earlier than females ($W = 256$, $p = 0.03$). Moreover, sex interacted with parity and season in meaningful ways. First, only multiparous mothers weaned males earlier than females ($W = 147$, $p = 0.01$). Second, males born during the birth peak were weaned faster than all others ($W = 23$, $p = 0.0003$). Finally, multiparous mothers weaned female infants born during the birth peak earlier than primiparous mothers did ($W = 28$, $p = 0.03$). In conclusion, male infants born during the peak to multiparous mothers are weaned earlier than all other infants. Future work will examine how time to weaning may affect survival outcomes for infants and later reproductive success for mothers.

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Testing the Accuracy of Sex Estimation from the Metacarpals, Calcaneus, and Talus on a Sample of Known Sex Individuals

KATLYN CASAGRANDE and PATRICIA LAMBERT

Department of Sociology, Social Work, and Anthropology, Utah State University

Forensic anthropologists and bioarchaeologists are frequently tasked with the identification of human skeletal remains, which includes an estimation of the sex of the deceased individual. Researchers can be extremely accurate if they have access to the complete skeleton, though this is often not the case due to issues of preservation, scavengers, and recovery conditions. The presented research investigates the efficacy of the metacarpals, calcanei, and tali for use in sex estimation in cases of limited skeletal preservation, as well as determining exactly which measurements are most useful for sex estimation. The presented research narrows the list of measurements needed for each bone to obtain the highest level of accuracy. 110 black and white individuals from the William M Bass Donated Skeletal Collection were included in the experiment and the specific measurements used on each bone were compiled from previous researchers. Discriminant function analysis found that specific combinations of measurements on each of the bones provided sex estimates with accuracy rates above 90%. Based on these results, we can conclude that the metacarpals, calcaneus, and talus are accurate measures of sex and thus viable options for sex estimation.

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Environmental and cultural pressures on human infectious disease

ELIZABETH CASHDAN

Anthropology, University of Utah

Pathogens have played a major role in human demographic history. It is important, therefore, to understand the factors that affect human pathogen prevalence. This study explores effects on pathogen prevalence of (a) islands; (b) drought; (c) sedentism, roads, and population density; and (d) temperature, with implications for global warming. The analyses use environmental and cultural data from the 186 mostly small-scale societies of the Standard Cross-Cultural Sample, together with pathogen prevalence in each area derived from mid-twentieth century sources.

Results: (a) Consistent with expectations from island biogeography, pathogen prevalence and richness was lower on islands than on the mainland, and increased linearly with log island area. (b) Although mosquito-borne diseases (malaria, dengue, filariasis) were prevalent in areas with moderately high mean annual rainfall, dry extremes exacerbated another suite of diseases (typhus, leishmanias), probably because of increased aggregations of people with these disease vectors. (c) Pathogen prevalence was higher where populations were dense, settled, and connected by roads, with density being particularly important in non-tropical areas, perhaps because there are more alternate hosts in the tropics. (d) Pathogen prevalence is greater where climates are hotter, with the greatest effect in non-tropical areas, where energy is limiting. When the climate is also frost-free year-round, there is an additional increase in pathogen prevalence, probably because of the effect of frost on insect vectors.

The Bioarchaeology of Care for Individuals with Reduced Mobility in Non-Sedentary Societies

ANNAMARIE CASSERLY and BRIANA R. MOORE

Anthropology, University of Kentucky

Pathological conditions and traumatic injuries that impacted mobility may have been particularly disruptive within forager communities. This research project utilizes a populational approach to the bioarchaeology of care to explore the impact of reduced mobility at the Barrett site (15McL4), a Late Archaic sample from Kentucky. The Barrett site is located within the Green River region, and while minimal research has been performed on the site, several hundred individuals were excavated during the Works Progress Administration. Using the bioarchaeology of care methods, we examine individuals exhibiting conditions suggestive of impacted mobility, including patellar fusion, severely misaligned healed fractures of the leg, and the destruction of the acetabulum. We then determine the likely health provisioning provided, as indicated through the healing and continued survival of potentially immobile or mobility-reduced individuals. Our research also explores the possibility of normalized care for individuals with reduced mobility within these communities via an analysis of burial practices. This project provides an example of how community-focused bioarchaeology of care may be performed in populations with a reduced archaeological footprint. It emphasizes the importance of contextualizing pathological conditions through the consideration of lifeways and subsistence strategies in the bioarchaeology of caregiving, and the unique burdens immobility may have entailed in forager societies.

Locomotor-respiratory dynamics and gait frequency tuning in humans

ERIC R. CASTILLO[1] and HERMAN PONTZER[1,2]

[1]Department of Anthropology, Hunter College, City Univ. of New York, [2]NYCEP, New York Consortium for Evolutionary Primatology

In galloping quadrupeds, sagittal trunk bending and horizontal propulsive and braking forces cause a piston effect as viscera and soft tissues attached to the diaphragm and body wall accelerate back and forth. This leads to 1:1 locomotor-respiratory (LR) coupling in most mammals but not bipedal humans. Although variable or asynchronous LR patterns may have benefits, the effects of visceral mass (VM) displacement remain substantial for bipeds. How is human respiratory function affected by VM motions during locomotion? Here we model LR interactions as a harmonically oscillating system using published data on mammalian ventilation, gait, and experimental studies of VM displacement. We combine these with *ex vivo* measurements of the diaphragm's natural frequency (Fn) across mammals of varying size to model the resonance response and LR dynamics of different taxa. Consistent with previous studies, galloping mammals evolved stride and breathing frequencies that are tuned to the resonance of their respiratory systems, suggesting less muscular work is required to breathe during locomotion. In humans, breathing frequencies are 80% lower than Fn, but step frequencies overlap the Fn bandwidth. Within this resonance range, estimates for the quality factor of the human LR resonator suggest that 60% more energy is stored relative to lost from the muscular work needed to maintain ventilation amplitude per cycle. These findings suggest that, unlike most mammals, humans do not show LR resonance-assisted ventilation. Instead humans have evolved gait patterns tuned to the diaphragm's mechanical properties enabling a reduction in the costs associated with resisting VM displacements during locomotion.

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How social inequalities are embodied as differential risk for pathologies among the poor: Trends in HIV incidence among youth and adolescent pregnancy in Latin America and the Caribbean

ARACHU CASTRO

Global Community Health and Behavioral Sciences, Tulane University School of Public Health and Tropical Medicine

The incidence of HIV infection has been declining throughout the past 15 years among youth populations in Latin America and the Caribbean (LAC). On the other hand, 17 per cent of births in 2010-2015 occurred among adolescents in this same region, which has the highest concentration of adolescent pregnancies in the world. This presentation seeks to offer insight on the factors that drive decreasing incidence of HIV and increasing rates of adolescent pregnancy throughout LAC despite the fact that both involve unprotected sex. Drawing from both qualitative and quantitative analyses, the paper incorporates a health equity perspective to examine: 1) which groups of adolescents are most vulnerable to acquire HIV and/or have early pregnancies and 2) what are the factors fueling that vulnerability. The methodology includes the quantitative analysis of Demographic and Health Surveys, Multiple Indicator Cluster Surveys, and UNAIDS databases and a comprehensive review of research articles published in English, Spanish, and Portuguese between 2000 and 2017 that focus on the social determinants of sexually transmitted HIV and adolescent pregnancy. Poverty is a common theme that connects all of the factors that increase exposure and social vulnerability to both HIV and adolescent pregnancy, such as early sexual initiation, sexual coercion, intergenerational sexual relations and drug and alcohol abuse, all of which occur more frequently among adolescents from poor and vulnerable settings, particularly among female adolescent from low socioeconomic position. A research approach that combines medical anthropology and epidemiology analyses contributes to elucidating new trends in the HIV epidemic.

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Dental wear of the mandibular deciduous fourth premolar in a cross-sectional analysis of six great ape species

KIERSTIN K. CATLETT[1] and E. SUSANNE DALY[2,3]

[1]Anthropology, Normandale Community College, [2]School of Human Evolution and Social Change, Arizona State University, [3]Institute of Human Origins, Arizona State University

Tooth wear modifies and reshapes the occlusal surface via loss of dental tissues. Changes to the occlusal topography are not necessarily disadvantageous, as decades of previous research demonstrate that teeth wear in manner that maintains functional capabilities. To date, most of this work focuses on permanent teeth. Great ape deciduous teeth remain in functional occlusion for years; however, it is unknown whether deciduous teeth wear in a manner that maintains occlusal topography. This study tests whether the occlusal terrain is preserved in great ape lower deciduous fourth premolars (dp_4s). Casts were generated from high-resolution molds (N=278) obtained from museum specimens representing six great ape species. Only non-captive juveniles were included to represent wear from a natural diet. Relative dental developmental ages were assigned to each specimen. Scanned casts were measured using dental topographic analyses. Changes over time in occlusal gradients (slope) and other measures of occlusal terrain (angularity, relief index, and orientation patch counts rotated) were analyzed using linear and segmented regressions (best fit chosen using AICc). Aside from *Pongo pygmaeus*, all other species exhibited evidence of occlusal topographic maintenance for at least one variable. In some cases, segmented regression breakpoints identified changes in dp_4 wear that occurred shortly before or during the emergence of the second mandibular molar (M_2), suggesting molar emergence mitigates the effects of dp_4 wear in some great ape species. Overall, this study suggests that mechanisms exist to preserve occlusal topography throughout dp_4 wear. Our results are discussed within an ecological, developmental, and functional framework.

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Immune response to soil-transmitted helminths is associated with reduced intestinal inflammation: Preliminary evidence from Amazonian Ecuador

TARA J. CEPON-ROBINS[1], THERESA E. GILDNER[2], JOSHUA SCHROCK[2], GEETA EICK[2], ALI BEDBURY[2], MELISSA A. LIEBERT[3], SAMUEL S. URLACHER[4], FELICIA C. MADIMENOS[5], CHRISTOPHER HARRINGTON[2], DORSA AMIR[6], RICHARD G. BRIBIESCAS[6], LAWRENCE S. SUGIYAMA[2] and J. JOSH. SNODGRASS[2]

[1]Department of Anthropology, University of Colorado Colorado Springs, [2]Department of Anthropology, University of Oregon, [3]Department of Anthropology, Northern Arizona University, [4]Department of Anthropology, Hunter College (CUNY), [5]Department of Anthropology, Queens College (CUNY), [6]Department of Anthropology, Yale University

Soil-transmitted helminths (STHs; parasitic worms) share a long coevolutionary history with humans and may thrive in host intestines by decreasing inflammation. Thus, limited exposure to STHs, especially in economically developed nations, is hypothesized to increase the prevalence of disorders related to intestinal inflammation, like Inflammatory Bowel Disease, though this has not been well tested. The present study tests relationships between STH infection and Fecal Calprotectin (FC), a measure of intestinal inflammation, among the Shuar, an indigenous population from Amazonian Ecuador experiencing rapid yet varied social/economic change. We hypothesize: 1) FC will be lower in STH infected individuals; and, 2) FC will be negatively correlated with Immunoglobulin E (IgE), a long-term marker of adaptive immune response to parasites. Seventy-nine participants (36 children [<15 years]; 43 adults [≥15 years]) provided fecal samples for STH/FC analyses, while 39 (13 children, 26 adults) provided bloodspot samples for IgE analysis. Forty-one participants (52%) were infected with at least one STH species, while 38 (48%) were uninfected. Based on FC levels, 50 (63%) individuals had no gastrointestinal inflammation (<50 ug/g), 24 (30%) had mild

inflammation (50-200 ug/g), and 5 (6%) had elevated inflammation (>200 ug/g). Contrary to expectations, there were no significant relationships between FC and infection status. As hypothesized, IgE was negatively correlated with FC (p < 0.05) among adults, suggesting long-term immune responses to STHs (not current infection status) may be related to decreased inflammation. Further analyses will explore these relationships and compare intestinal inflammation in the Shuar to other populations around the world.

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Taxonomic classification of hominoid upper and lower first molar crown outlines: which molar and which method works best?

PAOLA CERRITO[1,2], ALEJANDRA ORTIZ[3], CLARE M. KIMOCK[1,2], KAI HE[4] and SHARA E. BAILEY[1]

[1]Center for the Study of Human Origins, Department of Anthropology, New York University, [2]New York Consortium in Evolutionary Primatology, NYCEP, [3]Institute of Human Origins, School of Human Evolution and Social Change, Arizona State University, [4]The Kyoto University Museum, Kyoto University

Geometric morphometrics is an increasingly popular method for identifying species in the hominin fossil record. Tooth crown outlines have proven to be particularly useful in distinguishing closely related Middle-Late Pleistocene taxa. Several independent studies have noted different diagnostic ability of, and levels of variation in, the maxillary and mandibular first molars in a variety of taxa. This study aims to answer three questions that are relevant to making decisions regarding the choice of tooth type, the number of landmarks used to capture meaningful taxonomic information, and the method used to quantify outline shape. We compared the accuracy of Elliptic Fourier Analysis (EFA) and regular geometric morphometric analysis using semi-landmarks through principal component analysis (PCA) and discriminant function analysis (DFA). We also tested the correlation between the number of landmarks (16, 30, 60) and classification accuracy. Our sample comprises nine species in Hylobatidae (representing all extant genera) and the two species of *Pan*. Both taxa were analyzed separately. DFA and PCA were performed on Procrustes-transformed data and on Elliptic Fourier coefficients to assess the accuracy of each method. Results of the DFA showed that the EFA on M^1s with the highest number of landmarks produced the highest classification accuracy in Hylobatidae and *Pan* (>71%). The PCA indicated that maxillary and mandibular first molars were equally variable. This finding is consistent with earlier studies of Pleistocene hominins. We therefore suggest that the higher diagnostic value of M^1 may be a consequence of its greater susceptibility to evolutionary forces.

What lies beneath? Exploring the use of pre-antibiotic clinical radiographs in the study of tuberculosis

REBECCA CESSFORD

History, University of Hull

Archaeological examples of tuberculosis generally demonstrate chronic or healed pathology, observable macroscopically. In palaeopathology identification of tuberculosis is limited to the observation of an angular kyphosis in the spine, the only pathognomonic manifestation of the disease. Other macroscopic skeletal changes are mostly non-specific and can be attributed to a range of conditions. This impacts upon palaeopathological understanding of TB and its identification in skeletal remains in the absence of biomolecular analysis. An alternative, and relatively unexplored, approach to the study of skeletal tuberculosis is through the use of archived clinical radiographs that pre-date the antibiotic era. These demonstrate the disease in early, chronic and healed stages. Using records from Stannington Children's Sanatorium, UK dating from 1935-1953 this approach was explored. Information was collated from casefiles of patients admitted with tuberculosis for the bones and joints with surviving radiographic images (n=314). Analysis of these records provided information on which bones(s) were involved, location of disease and pathology observed.

The Stannington records supported contemporary literature on the pattern of affected bones; the spine, hip and knee were most frequently affected though in differing proportions to the literature. The images demonstrated that in early stages of infection manifestations were largely located within the bone, not observable macroscopically. New bone formation was also observed frequently in association with joint disease. The use of pre-antibiotic radiographs and medical files offer a potential new approach to the study of palaeopathology. Furthermore, pre-antibiotic clinical radiographs provide a comparative resource for radiographs of dry bone with possible tuberculosis.

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The biomechanics of arboreal stability in gray squirrels and new world monkeys: further insights into the unique aspects of quadrupedal locomotion in nonhuman primates

BRAD A. CHADWELL[1], ADRIENNE N. WOLFE[2] and JESSE W. YOUNG[2]

[1]Department of Anatomy, Idaho College of Osteopathic Medicine, [2]Department of Anatomy and Neurobiology, Northeast Ohio Medical University

Primate evolution is intimately tied to arboreality, and decades of *in vivo* laboratory research (much of it at the Stony Brook Primate Locomotion Laboratory) have established how the unique kinematics and kinetics of primate quadrupedalism appear to be associated with locomotion on narrow, precarious arboreal supports. However, attempts to explain primate morphological and locomotor synapomorphies as "arboreal adaptations" are hampered by the existence of non-primate mammals that lack such features, but are nonetheless committed arborealists. Here, we empirically test the prediction that primate-like grasping and locomotor kinematics confer a performance advantage relative to other arboreal mammals. We collected high-speed video of gray squirrels (*Sciurus carolinensis*) crossing broad (5cm) and narrow (2.5cm) diameter poles instrumented with force/torque transducers, and compared these data to matching datasets from similarly-sized New World monkeys - marmosets (*Callithrix jacchus*) and squirrel monkeys (*Saimiri boliviensis*). Squirrels consistently used high-speed bounding and galloping gaits across both substrates, moving significantly faster than either of the primates ($p<=0.018$). Given that rolling plane angular momentum was negatively correlated with speed across species ($r=-0.687$, $p<0.001$), squirrels likely moved quickly to dynamically increase lateral stability. When transitioning from the broad to the narrow pole, squirrels consistently required the greatest magnitudes of adjustment (i.e., changes in speed, duty factor, and overall substrate contact duration; squirrel effect sizes: 0.245-0.726; primate effect sizes: 0.026-0.422). Our findings provide empirical support for the hypothesis that functional aspects of primate anatomy and gait mechanics evolved in response to selective pressures to increase locomotor performance on narrow arboreal supports.

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Reconstructing the Demographic History of Black-and-White Ruffed Lemurs (*Varecia variegata*) in Ranomafana National Park

APARNA CHANDRASHEKAR[1], AMANDA N. MANCINI[2,3] and ANDREA L. BADEN[1,2,3]

[1]Anthropology, Hunter College, [2]Anthropology, The Graduate Center of City University of New York, [3]The New York Consortium in Evolutionary Primatology

Madagascar is host to an exceptional and unique level of biodiversity not seen anywhere in the world. However, large scale anthropogenic pressures and landscape change has resulted in the extinction of several endemic megafauna, as well as the decline of many extant species. Ongoing deforestation threatens the stability and viability of extant lemur populations, including the Critically Endangered black-and-white ruffed lemur (*Varecia variegata*). Previous studies suggest this species has experienced a recent genetic bottleneck across its range, even within large, continuous tracts of rainforest, such as Ranomafana National Park (RNP). To understand the timing and magnitude of this bottleneck event within RNP, we constructed an Extended Bayesian Skyline-Plot (EBSP). This method utilizes genomic data to track changes in effective population size (N_e) through time, enabling us to assess historic N_e and predict if and to what degree decreases may have occurred. To achieve this, we collected fecal samples from four locations within RNP and– using a suite of ten microsatellite markers– genotyped and identified 38 unique individuals. Using these data, we found that the N_e within RNP remained constant at an approximate size of 1150 individuals until 300-400 years before present, after which it experienced a severe contraction. At this time, the N_e in RNP has steadily decreased to the current estimate of approximately 122 individuals. The identified decline coincides with an increase in human settlement and population size in Madagascar, suggesting that anthropogenic pressure may have contributed to the bottleneck signature we see today.

Poison, primates, and cytochrome P450s: The evolution of xenobiotic-metabolizing enzymes among primates

MORGAN E. CHANEY[1,2], HELEN PIONTKIVSKA[2,3] and ANTHONY J. TOSI[1,2]

[1]Department of Anthropology, Kent State University, [2]School of Biomedical Sciences, Kent State University, [3]Department of Biological Sciences, Kent State University

The human genome encodes at least 11 cytochrome P450 enzymes that metabolize numerous xenobiotic compounds, including plant-defensive compounds and over 70% of pharmaceuticals. The pharmacology of P450 enzymes has been studied extensively, but our understanding of molecular evolution of this gene superfamily is incomplete, partly because the number of P450 homologs varies across genomes. Thus, we aimed to establish evolutionary relationships among primate P450 genes using 16 publicly available genomes, and to link patterns of selection and gene duplication with known dietary trends because these enzymes play a role in potential predator-prey relationships between primates and the plants that they consume. For example, the *CYP2C* cluster of genes showed a qualitatively different evolutionary pattern among hominoids as compared to cercopithecoids. Our maximum-likelihood phylogeny of *CYP2C* homologs shows that hominoids have either maintained or reduced the primitive number of functional genes. Old World monkeys showed a pattern of retaining symplesiomorphic *CYP2C* and *CYP2D* paralogs as well as secondarily duplicated *CYP2C* paralogs. Our analysis of nonsynonymous substitutions shows that selection has not acted equally on each lineage of orthologous genes. For example, more codons from the *CYP2C20* group exhibited signatures of positive selection than did genes from the *CYP2C19* cluster—despite evidence that these genes are closely related. Overall, our findings support the hypothesis that primate P450s have evolved in response to selective pressures provided by dietary toxins. Viewed alongside known data on primate feeding ecology, our results indicate evolutionarily deep differences in ecology or physiology among higher-order primate taxa.

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Migration, admixture and assimilation: case of Jewish and Parsi populations in India

GYANESHWER CHAUBEY

Zoology, Banaras Hindu University, Varanasi

The existence of Jewish and Parsi communities in India is noted since ancient times. However, due to the lack of written records or inscription, their origin and affiliation with other Jew populations remains shrouded in legends. Previous genetic studies on Indian Jewish populations have found evidence for a minor shared ancestry of Indian Jewish with Middle Eastern (Jewish) populations, whereas for Parsi's the Iranian link was proposed. However, these studies had relied on fewer individuals and haven't studied the detailed admixture process of Indian Jewish and Parsis with the local Indian populations. Here in large sample size using a combination of high resolution biparental and uniparental markers (Y chromosome and mitochondrial DNA), we reconstruct a broad genetic profile of Indian Jewish and Parsis, focusing on the effects of cultural practices on patterns of genetic diversity.

Phylogenetic and phylogeographic evidence for two species of muriqui (genus *Brachyteles*)

PAULO B. CHAVES[1,2], TIELLI MAGNUS[3], LEANDRO JERUSALINSKY[4], MAURÍCIO G. TALEBI[5,6], KAREN B. STRIER[7], PAULA BREVES[8], FERNANDA TABACOW[9], RODRIGO H. F. TEIXEIRA[10], LEANDRO MOREIRA[11], ROBSON HACK[12], ADRIANA MILAGRES[13], ALCIDES PISSINATTI[14], FABIANO R. DE MELO[15], CECÍLIA PESSUTTI[16], SÉRGIO L. MENDES[17], TEREZA C. MARGARIDO[18], VALÉRIA FAGUNDES[17], ANTHONY DI FIORE[19] and SANDRO L. BONATTO[3]

[1]Department of Anthropology, New York University, [2]NYCEP, New York Consortium in Evolutionary Primatology, [3]Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, [4]Centro de Primatas Brasileiros, Instituto Chico Mendes de Conservação da Biodiversidade, [5]Departamento de Ciências Ambientais, Universidade Federal de São Paulo, [6]APM, Associação Pró-Muriqui, [7]Department of Anthropology, University of Wisconsin-Madison, [8]Diretoria de Biodiversidade, Sociedade Ecoatlântica, [9]MIB, Muriqui Instituto de Biodiversidade, [10]Programa de Pós-Graduação em Animais Selvagens, Universidade Estadual Paulista (Botucatu), [11]CECO, Centro de Estudos Ecológicos e Educação Ambiental, [12]LACTEC, Instituto de Tecnologia para o Desenvolvimento, [13]Programa de Pós-Graduação em Ecologia Aplicada, Universidade Federal de Lavras, [14]CPRJ, Centro de Primatologia do Rio de Janeiro, [15]Departamento de Ciências Biológicas, Universidade Federal de Goiás (Jataí), [16]Zoo de Sorocaba, Parque Zoológico Municipal Quinzinho de Barros, [17]Departamento de Ciências Biológicas, Universidade Federal do Espírito Santo, [18]Departamento de Pesquisa e Conservação da Fauna, Prefeitura Municipal de Curitiba, [19]Department of Anthropology, The University of Texas at Austin

The taxonomy of muriquis, the largest extant primates in the New World, is controversial. While some specialists argue for a monotypic genus (*Brachyteles arachnoides*), others favor a two-species classification, splitting Northern muriquis (*B. hypoxanthus*) from Southern muriquis (*B. arachnoides*). Although some phenotypic differences exist between these two forms, it is unclear whether these represent true synapomorphies or polymorphic traits unrelated to a possible speciation process. Molecular phylogenetic analysis could shed light on this problem, but requires sampling from multiple wild populations of these two highly endangered species. Between 2003 and 2017, we collected over 240 samples of muriqui feces from sites throughout the species' distribution in the Brazilian Atlantic Forest and sequenced a portion of HV1 of the mitochondrial DNA control region. Phylogenetic analyses of these sequence data robustly support two reciprocally monophyletic groups, separated by an average 10% genetic distance. The phylogeographic break between these lineages seems to be associated with the Paraíba do Sul river, in Rio de Janeiro. While published mitochondrial genomes and nuclear loci date the split between Northern and Southern muriquis during the early Pleistocene (ca. 2.0 mya), our dataset places the coalescence time for each of these two clades at ~0.28 and ~0.36 mya, respectively. Collectively, our results support recognizing Northern and Southern murquis as distinct species that should be managed as independent evolutionarily significant units (ESUs). Given that a total of only a few thousand muriquis remain in nature, it is

imperative that conservation efforts be made to protect both species from extinction.

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Pinpointing Porosity: An Exploration of Normal Variation in Juvenile Vertebral Porosity as it Relates to the Differential Diagnosis of Tuberculosis

SYLVIA CHEEVER[1], JANE BUIKSTRA[2], ALIYA HOFF[2], SAM MIJAL[3] and MARK SIMON[4]

[1]Department of Anthropology, The University of Chicago, [2]School of Human Evolution and Social Change, Arizona State University, [3]Department of Anthropology, California State University, Chico, [4]Department of Anthropology, Texas State University

Disseminated tuberculosis (TB) can cause severe vertebral involvement, including vertebral collapse and kyphosis. Identification of disseminated tuberculosis in archaeological remains has historically relied upon this extreme pathologic destruction for diagnosis. Some researchers have argued that during early stages of infection, especially in juveniles, small-scale porotic vertebral changes occur, and are indicators of TB. Previous studies have explored patterning of smaller-scale lesions and resorptive pitting on the vertebral bodies as indicators of short duration tuberculosis infection in adults and older juvenile remains. Due to the natural porosity of juvenile vertebrae resulting from arterial and venous supply systems present during development, it is impossible to distinguish normal developmental changes from indications of infection without explicit documentation of normal variation in juvenile vertebrae. Previous research has documented and scored juvenile vertebral porosity in Nubian populations with potential for TB infection, but no study has inspected a population with significantly low TB infection probability. This study employs visual observation to describe thoracic and lumbar vertebral porosity in 15 juvenile individuals from two consecutive chronological periods in west-central Illinois: the Middle Woodland period (150 BC to 400 AD) and the Late Woodland period (400-1050 AD). Both periods exhibit very low tuberculosis expectation. Through observation, the study describes normal variation in juvenile vertebral porosity and develops a scoring system for normal porosity. These findings are then used to critically analyze descriptions and photographs of minor lesions and resorptive pitting previously attributed to tuberculosis, establishing the possibility that the lesions are a product of normal variation.

Patterns of growth, childhood stress, and mortality risk during the Late Period in Central California

COLLEEN M. CHEVERKO

Anthropology, The Ohio State University

Previous studies of California prehistory suggest that individuals living during the Late Period (ca. 1200-200 BP) were more stressed due to unfavorable environmental circumstances than those who lived during earlier periods. Many of these studies rely on comparisons of lesion frequencies. This study builds upon previous work because it incorporates a paleoepidemiological approach to mortality risk using individuals interred in the Hotchkiss Mound (CA-CCO-138), a Late Period site from the Sacramento San Joaquin Delta region. Results indicate that individuals who developed bilateral linear enamel hypoplasias as a response to systemic stressors experienced significantly higher mortality risk across adulthood than individuals who did not (n=93, p=0.020). However, there were no differences in mortality risk between those who experienced growth stunting (measured using z-scores of bicondylar femoral length). These results indicate that the timing of stressors and the potential for catch-up growth may have affected an individual's mortality risk during life. Those who experienced systemic stress during early childhood likely experienced increased mortality risk as adults, but catch-up growth could buffer these associations, therefore adding a layer of adaptability to our understandings of unfavorable environmental circumstance. Furthermore, there were sex-based patterns of mortality risk in this sample, with males living significantly longer than females (n=126, p=0.027). This finding might be due to hormonal differences, differences in activities, or differences in cultural practice between the sexes.

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Obligate midwifery, Obstetric discordance and Unnatural selection: Can evolutionary perspectives move us beyond the too much too soon/too little too late dualism?

MELISSA CHEYNEY

Anthropology, Oregon State University

Using a numbers and narrative approach, the purpose of this project was to compare psychosocial and clinical outcomes across two maternity care systems in order to quantify and describe key outcomes of too much too soon (TMTS, United States) and too little too late (TLTL, Soroti, Uganda) systems with the ultimate goal of using evolutionary perspectives to move beyond this dualism. Findings reveal distinct maternal and neonatal risk profiles for TMTS systems that include high rates of iatrogenic maternal morbidity, nosocomial infections, and a concentration of disrespect and abuse. Conversely, TLTL systems are characterized by high rates of preventable maternal and neonatal death and severe "near-miss" obstetric complications like obstetric fistula. By juxtaposing cesarean section rates and associated, key maternal and neonatal outcomes across widely disparate systems, we can identify benchmarks, as well as the approaches needed to achieve these, as we work to apply evolutionary obstetrics to clinical practice and systems transformation. I argue that obligate midwifery, obstetric discordance and unnatural selection theories can be used, not only to explain global disparities in surgical birth and associated clinical consequences in TMTS and TLTL systems, but also to produce predictive models sensitive to socio-cultural and political-economic contexts that can be used to structure maternity care delivery systems in ways that move us beyond TMTS and TLTL to the right amount at the right time in the right way—that is, in a way that respects human rights in childbearing.

The use of resting breaks changes blood perfusion during paddling bouts

HAYLEY K. CHEYNEY KANE[1] and CARA M. WALL-SCHEFFLER[1,2]

[1]Biology, Seattle Pacific University, [2]Anthropology, University of Washington

The body uses blood perfusion (BP) to reduce heat load: as core body temperature increases, vasodilation allows blood to leave the core and flow along the body's periphery, allowing the blood to cool near the body's skin/surface. Clear ethnographic evidence shows that many foraging groups stop and rest at regular intervals; it is possible that the number and length of time of these rests leads to a reduced heat load associated with working tasks, and allow humans to work for longer. Here we look at BP during bouts of canoeing. People (N=16) paddled continuously across an outdoor lake for 6- or 12-minute bouts followed by short and long rests. Using a Doppler-style Colormeter, we measured BP before and after each rest and paddling bout at seven anatomical locations, the anterior wrist and palm; the forearm, bicep and shoulder; the jugular notch; and the forehead. Using repeated measures ANOVAs to test whether long or short rests allowed for adequate BP, the jugular notch, biceps and palm showed substantial changes in BP based on resting lengths. The jugular notch region has a thermoregulatory function and shows marked increases in BP with longer rest times after both short bouts (p=0.05) and long bouts (p=0.066). Tissues that are metabolically active during paddling, such as the biceps and the palm, also show increased BP when the paddling length is kept constant but the rest increases (p=0.128, p=0.064 respectively). Thus, using

resting bouts of 12 minutes does allow humans to cool down metabolically active tissue.

aDNA Analysis Indicates Genetic Discontinuity After the Collapse of the Wari Empire

AINASH CHILDEBAYEVA[1,2], KELLY HARKINS[3], JANNINE NOVAK[3], ABIGAIL W. BIGHAM[1], TIFFINY TUNG[4], MARTHA CABRERA[5], JOSE OCHATOMA[5] and LARS FEHREN-SCHMITZ[3]

[1]Anthropology, University of Michigan, [2]Environmental Health Sciences, University of Michigan, [3]Anthropology, University of California – Santa Cruz, [4]Anthropology, Vanderbilt University, [5]Anthropology, Universidad de San Cristobal de Huamanga

The Wari Empire thrived in the Central Andes between AD600 and 1000 and influenced the material culture in many parts of the Peruvian Andes. However, it is unknown if the presence and the collapse of the Wari empire had an effect on the population structure of the region. To address that question, we undertook an aDNA analysis of post-Wari remains. Genomic DNA was extracted from teeth of 24 samples excavated from site of Huari, the capital of the Wari Empire. Samples date to the post-Wari era (AD1300-1400). Molecular sex was determined for all samples and mtDNA HVR-1 region was sequenced for 22 samples. Molecular sex was consistent with osteological sex determination for 16 out of 19 samples. F_{ST} genetic distance analysis was performed on the post-Wari samples together with previously published HVR-1 data from various ancient Andean populations representing a time frame from the Late Archaic to the Late Intermediate Periods. Our results suggest genetic discontinuity between Wari (Middle Horizon) and post-Wari (Late Intermediate Period) populations in the Wari heartland. In contrast to earlier, smaller studies that could not reject population discontinuity, this study suggests that Wari imperial collapse resulted in changes in the genetic structure of the mortuary populations from the heartland.

Interestingly, based on nuclear DNA sequencing we identified single-nucleotide polymorphisms in regulatory regions and introns, and novel genetic variants associated with the genes implicated in high-altitude adaptation (*ABO, EGLN1, DRD4, EPAS1, VEGFA,* and *VEGFB*) suggesting potential genetic signatures of high-altitide adaptation in the individuals from our cohort.

This project was funded by the National Science Foundation BCS-Archaeology, the Leakey Foundation, the Department of Anthropology at the University of Michigan, the College of Arts and Science at Vanderbilt University.

Genome-wide signatures of differential introgression in a Zambian baboon hybrid zone

KENNETH L. CHIOU[1,2], CHRISTINA M. BERGEY[3,4,5,6], TODD R. DISOTELL[5,6], JEFFREY ROGERS[7], CLIFFORD J. JOLLY[5,6] and JANE E. PHILLIPS-CONROY[2,8]

[1]Department of Psychology, University of Washington, [2]Department of Anthropology, Washington University, [3]Department of Anthropology, Pennsylvania State University, [4]Department of Biology, Pennsylvania State University, [5]Department of Anthropology, New York University, [6]New York Consortium in Evolutionary Primatology, [7]Human Genome Sequencing Center, Baylor College of Medicine, [8]Department of Neuroscience, Washington University School of Medicine

Hybridization in the wild offers valuable insights into mechanisms of natural selection. By creating novel genetic combinations from distinct populations or species, hybridization provides a natural experiment for evaluating selection on alleles in new genomic backgrounds. In this study, we examine a baboon hybrid zone in the Kafue river valley of Zambia, where Kinda baboons (*P. kindae*) and gray-footed chacma baboons (*P. ursinus griseipes*) coexist and hybridize despite unusually large body size differences between them. Using FecalSeq and double-digest RADseq, we genotype hundreds of baboons at >10,000 autosomal SNPs. Comparing our data to previously reported mitochondrial DNA and Y chromosome results, we find significantly directional Kinda>chacma introgression of Y-DNA relative to both mtDNA and autosomal DNA. Using a Bayesian genomic cline model, we find evidence for significantly restricted introgression of genes in the JAK/STAT signaling pathway, which plays an important role in growth hormone signaling, providing a possible mechanism for selection against body size differences in the hybrid zone. We also find evidence for significantly directional chacma>Kinda introgression in genes from immune pathways, such as toll-like-receptor and interferon-gamma signaling, as well as *ODF2*, a gene playing an important role in sperm tail function. The directional penetration of the species boundary of Kinda Y-DNA despite their small size remains an unexplained pattern, but may be explained by selection on Y-linked traits. One possible mechanism is epistatic selection on Y-DNA in the context of sperm-related hybrid dysgenesis, a pattern that has been reported in European house mouse hybrids.

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Studying canid trabecular bone morphology to understand human self-domestication

HABIBA CHIRCHIR[1,2] and FRANK R. O'KEEFE[1]

[1]Biological Sciences, Marshall University, [2]Human Origins Program, National Museum of Natural History, Smithsonian Institution

The human self-domestication (HSD) hypothesis proposes that modern humans underwent self-domestication in the Holocene as observed in certain morphological traits. These include a slight reduction in cranial capacity and a gracile skull. These changes are similar to those observed in other mammals thought to have undergone self-domestication, including bonobos and dogs. Additionally, modern human limbs show a decrease in trabecular bone density relative to early modern humans and neanderthals. This is attributed to differences in activity levels based on subsistence strategy, although there are suggestions that this reduction could be systemic. Interestingly, trabecular density has not been studied in other mammals that underwent self-domestication. We propose to compare trabecular density of domestic dogs with their close wild relatives to understand the possible effect of domestication on trabecular morphology. We test the hypothesis that domestic dogs have low trabecular density compared to gray wolves and red foxes due to relaxation of selection pressures for larger and stronger bones/bodies. We use microCT scanning to quantify trabecular density in the femoral and humeral heads of domestic dogs, wolves and foxes. Wilcoxon-tests show that the wolves and foxes have significantly greater trabecular density than the domestic dogs, supporting our hypothesis, although variations exist among dog breeds suggesting differences due to breed specialization. These preliminary results imply that selection for gracile skeletons was favored with other documented traits such as prosociality, as observed in humans. Incorporation of basal and feral dog breeds such as dingos in these comparisons would be beneficial in further understanding HSD.

Multivariate selection on human size and shape in East Asia

ELIZABETH O. CHO, GREGORY E. BLOMQUIST and LIBBY W. COWGILL

Department of Anthropology, University of Missouri

Ecogeographic body proportions have been well studied in Africa, Europe, and recently the Americas. However, Asia with its varied climate, high population density, and long, complex history of colonization has been conspicuously absent from most studies of morphological thermoregulatory adaptation. Recent research has emphasized the need to evaluate adaptive scenarios in a multivariate framework and critically test such scenarios against neutral

alternatives. Additionally, the majority of traditional climate studies have limited their focus to evaluation of male morphology, leaving unexplored the possibility of sexes adapting to climatic factors in different manners and intensities. We used male and female skeletal data to evaluate the strength of selective pressures on both sexes from differing latitudes in Asia (China, Japan, Korea, Thailand, and the Philippines). Measurements of the femoral head and maximum lengths of upper and lower limb elements were compared to sub-Saharan African populations to calculate selection gradients. Of the five traits evaluated, body mass appears to be under the strongest selection to increase with latitude based on the selection gradient results of femoral head diameter, with a weaker signal for selection to reduce tibial length with latitude in East Asia. Selection gradients are similar for the sexes, but often differ in magnitude. These findings emphasize the importance of including Asian biodiversity, and considering both sexes when assessing ecogeographic adaptation.

Portion of data used in this research was collected with support from the Oak Ridge Institute for Science and Education (ORISE).

Immunological age estimation for forensics

SOHEE CHO[1], HWAN YOUNG LEE[2], JI HYUN LEE[3], MOON YOUNG KIM[3] and SOONG DEOK LEE[3]

[1]Department of Chemistry, Florida International University, [2]Department of Forensic Medicine, Yonsei University College of Medicine, [3]Department of Forensic Medicine, Seoul National University College of Medicine

Age estimation from biological samples is helpful in identifying unknown persons by providing clues for predicting appearances, which has been one of the challenges in both forensic genetics and anthropology. Although there have been different anthropological and biological approaches to estimate age, availability of samples, accuracy of estimation and reliable techniques are still important issues for practical use. Human age can be estimated through age-related changes in body. The content of signal-joint T-cell receptor excision circle (sjTREC) in blood is negatively correlated with age, which can be measured through simple, robust and sensitive real-time PCR. In a model of 172 Koreans, the sjTREC level and age were correlated with r^2=0.648 through linear regression analysis, and the standard error of the estimate was 8.49 years. For other tissue samples, 33 thymus and spleen samples from autopsy, less correlation than blood were found with r^2=0.168 and r^2=0.374, respectively, but its usability was confirmed in real forensic cases with thymic samples only available. Age-related DNA methylation level is also a highly promising age-predictive marker proposed in recent, and applying independent multiple predictors was expected to increase accuracy of age estimation. Combining sjTREC quantification and DNA methylation assay significantly increased accuracy of estimation in the eldest group (>70 years). The results suggest that sjTREC quantification for estimating age is an applicable method in forensic cases where blood or bloodstains are available. With this method, the availability of other types of samples also should be considered for expanded use with other methods in further study.

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Current progress in the forensic entomological baseline data collection and associated software development program supported by the Korean National Police Agency

JINHYUK CHOI[1], SANG EON SHIN[1], IM-JOO RHYU[2] and SEONG HWAN PARK[1]

[1]Legal medicine, Korea University College of Medicine, [2]Anatomy, Korea University College of Medicine

Entomological evidence is useful for the estimation of minimum postmortem interval (PMI-min) when the body is severely decomposed. In order to establish baseline forensic entomological data and develop a software program for PMI-min estimation specific to Korea, a research consortium was constructed for the first time with the support by the Korean National Police Agency (KNPA). This consortium consists of five research departments with the following focuses: DNA barcoding of necrophagous entomofauna, constructing an ecological database related to necrophagous insects, developing statistical models for forensic entomology and meteorology, generating PMI-min estimates based on the developmental gene expression clock of necrophagous fly, and producing associated software.

As preliminary results, we have successfully identified insect specimens, captured from decomposing piglets and fly traps using pork liver baits from three regions of Korea, by the morphological taxonomic identification and DNA barcoding methods. We have also developed a novel PMI-min estimation algorithm based on several factors that are highly correlated with air temperature, and offer on our webpage a software prototype for this algorithm-based PMI-min estimation using three sets of variables (samples collected from the crime scenes, accumulated degree hours, and larval length).

At the conclusion of this consortium project in three years, we expect that this research will impact casework in Korea by strengthening the investigation of decomposed remains.

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Living with climate extremes and behavioral coping in a population of chacma baboons in South Africa

SHAHRINA CHOWDHURY[1,2,3] and LARISSA SWEDELL[1,2,3,4]

[1]Anthropology, CUNY Graduate Center, [2]Primatology, New York Consortium in Evolutionary Primatology, [3]Anthropology, Queens College, [4]Archaeology, University of Cape Town

Environmental challenges in the form of temperature extremes, coupled with unusual precipitation, which lead to prolonged periods outside their thermoneutral zone, can be detrimental to the stress physiology of primates, and they may have behavioral responses that act in a thermoregulatory capacity. Unlike most primates which are adapted to living in the tropics, chacma baboons in the Cape Peninsula of South Africa, with its wet winters and dry summers, are unusual in experiencing extremes of both temperature and rainfall. We examined the effects of these climate patterns on stress hormone (fecal glucocorticoid) levels in the adult females (N=16) of a group of chacma baboons (*Papio ursinus*) in the Cape Peninsula, where temperatures ranged from 6–39º C and monthly rainfall ranged from 1–160 mm. We studied the behavioral responses of females, by examining variation in activity budgets, foraging patterns and social cohesion. Females' GC levels were significantly negatively correlated with mean monthly temperatures (r=-0.510, P=0.026). Their activity budgets differed between summer and winter, with baboons spending significantly more time feeding (Z=-3.309, P=0.001) and significantly less time resting during the winter (Z=-3.206, P=0.001). Cold temperatures, therefore, seem to represent an ecological constraint on these baboons. They may have behavioral mechanisms for thermoregulation as we found that in winter they spent more time in sunny, open areas, and were more cohesive as a group. Results of studies such as this can inform us about the potential negative effects of climatic extremes caused by anthropogenic climate change.

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Tracking damage to stable isotope values in bone exposed to x-ray microtomography

LAURA E. CIRILLO[1], GARY D. RICHARDS[2], ERIC J. BARTELINK[3] and DULA PARKINSON[4]

[1]Anthropology, University of Nevada, Reno,

[2]Biomedical Sciences, A.A. Dugoni School of Dentistry, University of the Pacific, [3]Anthropology, California State University, Chico, [4]Advanced Light Source, Lawrence Berkeley National Laboratory

Despite being commonly considered a non-destructive research technique, X-ray micrtomography results in significant chemical alteration to exposed bone. A number of effects on skeletal tissues have already been demonstrated, including indications of diagenesis in collagen and bioapatite stable isotope values. Expanding this analysis to include a larger sample size and a wider range of exposure conditions demonstrates the destructive outcome of continued exposure to photon energy.

Stable isotope analysis was conducted on 16 archaeological human bone samples under multiple conditions to test how dose and x-ray flux affect the change in isotopic signature. All samples were first analyzed for carbon and nitrogen isotopes of bone collagen, and carbon and oxygen isotopes of bioapatite using a standard preparation methods before samples from the same bones were then irradiated at 43KeV for either 1, 2 or 3 hours at the Advanced Light Source, Lawrence Berkeley National Laboratory. Each sample was then analyzed for variation in isotope values by dose.

The collagen samples exposed to synchrotron light for less than 3 hours showed significantly less diagenetic change than the samples exposed for longer periods of time. More negative $\delta^{13}C$ and $\delta^{15}N$ values, lower collagen yields, and heavily altered C/N ratios were seen in the samples exposed for 3 hours. Bioapatite $\delta^{13}C$ values became more negative after exposure to the synchrotron but exhibited less change than collagen samples. These results suggest chemical alteration to isotopes after exposure to x-ray tomography varies depending on dose and flux, indicating a threshold for significant chemical alteration.

Abnormal Cusp Morphology and Root Number in a Third Molar from Rathfarnham, Dublin

MELISSA A. CLARK and DEBBIE GUATELLI-STEINBERG

Anthropology, The Ohio State University

It is frequently stated that dental development is less vulnerable to environmental insults than skeletal development; however, environmental insults can result in delayed eruption, fluctuating asymmetry, and cusp morphological variation. Here, a rare case of a six-cusped, five-rooted upper left third molar (ULM3) in an individual (68:1) from a Medieval site in Rathfarnham, Dublin, Ireland (97E0140) is presented. To determine the size of this tooth relative to all other molars excavated from Rathfarnham, crown-height, mesiodistal, and buccolingual measurements were taken from six first molars, five second molars, and 12 third molars. The surface area of the crown was approximated by multiplying the buccolingual and mesiodistal width for all 12 third molars (M3s). The surface area of the ULM3 was 149.78mm, or 2.65 standard deviations above the mean (96.12mm). When compared to all molars, it was found that the surface area for the ULM3 was 2.77 standard deviations above the mean (102.75mm, n=23). Finally, the London Dental Atlas was used to estimate age for each of the molars from 68:1.The roots of ULM3 were developmentally delayed compared to the roots on the remaining M3s. Except for the ULM3, the apices of all M3s are fully fused. Thus, while the dental age for the ULM3 is approximately 16-17 years, the dental age for the remaining M3s is 20-23. Such fluctuating asymmetry and the deviation from average crown size are consistent with an environmental insult, although genetic and idiopathic causes should also be considered.

"War as Imposed Ecology: Conflict and Embodied Biology"

PATRICK F. CLARKIN

Anthropology, UMass Boston

The classic studies of human adaptation and accommodation focused on people living in challenging ecosystems such as high altitudes, deserts, circumpolar latitudes, etc. However, some of the most challenging "environments" are ones imposed by human agency, including living under war conditions. Media images from recent conflicts in Syria, Iraq, Afghanistan, Yemen, South Sudan, Myanmar, Ukraine, and Gaza remind us that – while all conflicts are unique – they are consistent in that they exacerbate a population's health. In that way, wars can be conceptualized as an "imposed ecology," as they are created by various polities, which then severely constrain the choices that individuals can make regarding their own well-being. For example, one anthropologist described the "bomb ecologies" of rural Laos, the legacy of a decade of widespread U.S. bombing in the 1960s and 70s which continues to inhibit farming and economic development to the present day.

This presentation will aggregate several studies from past and recent war-affected populations, addressing the myriad ways that war has been correlated with impaired development and health deficits. Epidemiological evidence shows that war consistently increases civilian mortality and physical trauma. It impairs mental health, childhood growth, and birth weight, and delays menarche. It has been associated with the developmental origins of health and disease in several populations. Leftover chemical contaminants and ordnance remain embedded in soils, and are linked to injury, cancer, and possible birth defects. In short, war often becomes embodied in biology, reducing individual agency and playing a role in health disparities.

Changes in use of racialized terms throughout the history of biological anthropology, 1946 – 2017

ELIZABETH S. CLAUSING and AMY L. NON

Anthropology, University of California, San Diego

The discipline of biological anthropology has historically been fraught with problematic approaches to the study of human race (e.g., from polygenism to exploitation of minority populations for research). Today, biological anthropologists continue to be engaged in ongoing debates over the role of racial and ethnic classification in anthropological research. Here we examine the use of racial terminology in biological anthropology research to determine how concepts of race and ethnicity have been applied by biological anthropologists over time in the US. We present a content analysis of the *American Journal of Physical Anthropology*, based on a systematic review of a randomly selected set of empirical research articles. We conducted three searches in PubMed using MeSH terms related to Americans of African descent (e.g., black, African-American, Negro, etc., 1946-2017, n=104), Americans of European descent (e.g., white, Caucasian, Euro-American, etc., 1946-2017, n=104), and terms related to Hispanic populations (e.g. Hispanic, Mexican-American, Latino/a, etc., 1954-2017, n=79). We identified differences in the ways the concepts of race and ethnicity have been used to refer to different populations, and interesting changes in the use of certain racial terms over time. For instance, articles referring to Hispanic populations often use the term "ethnicity," while articles referring to African- and European-American populations often use "race." Additionally, we identified noteworthy diachronic trends, such as an increasing preference of the term "European-American" over "Caucasian" in recent years. We offer recommendations for consistent and unbiased ways that biological anthropologists can use concepts of race and ethnicity in anthropology and other fields.

A biomechanical reappraisal of the femoral neck

ALEXANDER G. CLAXTON

Anthropology, Boston University

Stresses and their resultant strains are thought to directly influence the thickness of femoral neck cortex through bone functional adaptation. In this conception the thin superior cortex of modern humans is a result of the axially compressive force generated by their unique abductor mechanism, supposedly canceling out the bending force of the body weight and eliminating tensile stress on the superior aspect of the femoral neck.

The thick superior cortex in the femoral neck of some South African australopiths is inconsistent with the prevailing biomechanical model of the hominin hip joint, as it is presumed that the deep gluteal muscles in australopiths abduct the femur in a fashion similar to modern humans. An appended and refined 2D biomechanical model of the proximal femur during peak stress was developed. Relative tensile and compressive stresses were calculated from simulated forces using 2nd moments of area derived from micro-CT scans. The model does not predict compression on the superior aspect of the human femoral neck during normal bipedal locomotion. A comparison between relative bending moments and 2nd moments of area (a measure of resistance to bending) across anthropoid primates shows a clear positive correlation. While bending moments at the base of the neck are higher than at midneck, there is no clear difference in 2nd moments of area, suggesting that the supposedly higher stresses at neck base do not significantly affect deposition or turnover of bone on the superior aspect of the human femoral neck.

Kinematic strategies are scale-dependent during vertical climbing in primates

GARRET CLEMMONS[1], MICHAEL C. GRANATOSKY[2], DANIEL SCHMITT[3] and JANDY B. HANNA[4]

[1]Exercise Physiology, WVU School of Medicine, [2]Organismal Biology and Anatomy, University of Chicago, [3]Evolutionary Anthropology, Duke University, [4]Biomedical Sciences, WVSOM

Climbing is an important part of locomotion by almost all primates. Yet, the biomechanical characteristics of climbing by primates are known for a few groups thought to possess specialized morphological features, such as apes and atelines, and lorises. Few works, however, have considered more generalized primates or the effects of size on climbing behavior. Here, we present data on primates with a wide range of body mass (0.18 to 9.77kg) and morphology to better understand the relationship between, scale, form, and function during vertical climbing. Two to three individuals for each of eight species of primate were video-recorded climbing on narrow, arboreal poles. The hip, foot, shoulder, hand, and points on the pole were digitized in order to calculate hindlimb and forelimb angles relative to the trunk and to the vertical pole. These angles were determined at touchdown and liftoff. Scale-dependent strategies were observed for both touchdown and liftoff angles across species (Kruskal-Wallis $p < 0.0001$ to 0.0311; df=7). Smaller primates exhibit greater forelimb protraction at touchdown and greater forelimb retraction at liftoff, while larger primates exhibit smaller hindlimb protraction angles at touchdown and greater retraction angles at liftoff. These results suggest that as primates increase in size, they must rely more heavily on their hindlimb for upward movement. Such results suggest that climbing among early primates differed from that of later forms. Furthermore, these data attest to the importance of experimental work to identify functional strategies related to components of anatomy, body size, and ecology in primates.

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Genetics of risk and trauma exposure in Syrian refugee youth

CHRISTOPHER J. CLUKAY[1,2], RANA DAJANI[3], DIMA HAMADMAD[4], GHUFRAN ABUDAYYEH[4], CATHERINE PANTER-BRICK[5] and CONNIE J. MULLIGAN[1,2]

[1]Anthropology, University of Florida, [2]Genetics Institute, University of Florida, [3]Biology and Biotechnology, Hashemite University, [4]Taghyeer Foundation, Taghyeer Foundation, [5]Anthropology, Yale University

A robust body of work has investigated the extent to which exposures to trauma or stress impact physiological and psychosocial outcomes. Fewer studies have tested whether genetic variants can modify the associations between childhood adversity and mental health over time.

We investigated genetic variants associated with the risk of aggression and poor mental health using cohort data on 11-18 year old Syrian refugees, displaced to Jordan, who participated in a randomized trial evaluating a psychosocial intervention designed to alleviate profound stress and build resilience. Outcomes included symptom scores on measures of stress, insecurity, mental health and cortisol at three time-points. At baseline (n=315), Syrian youth reported high levels of insecurity and trauma exposure, averaging 6.5 lifetime events. Post-intervention, we measured outcomes for participants at 10 weeks (n=219) and 1 year (n=135) after baseline.

We examined genes previously linked to childhood exposure to adversity and later development of aggression, depression, anxiety and related characteristics: monoamine oxidase A (*MAOA*), brain-derived neurotropic factor (*BDNF*), fatty acid amide hydrolase (*FAAH*), and catechol-O-methyl transferase (*COMT*). High/low expression variants of *MAOA* in males were found to interact with trauma exposure (number of trauma events) in association with symptoms of distress and mental health before the intervention ($p = 0.0225$ and 0.03, respectively). Growth curve analysis was used to test the influence of genetic variants on psychosocial trajectories. This work contributes to our understanding of the biological underpinnings of health and development for youth affected by war and forced displacement.

The research was funded by the University of Florida and Elrha's Research for Health in Humanitarian Crises Programme (Wellcome Trust and the UK Government).

Deja chew: Dietary food mechanical properties influence chewing behavior in primates

SUSAN COINER-COLLIER[1], GABRIELA PORTMANN[1], NATALIE E. HOWE[1], HUI DING[1], ANNIKA L. FLING[1] and MATTHEW J. RAVOSA[1,2,3]

[1]Department of Biological Sciences, University of Notre Dame, [2]Department of Aerospace and Mechanical Engineering, University of Notre Dame, [3]Department of Anthropology, University of Notre Dame

Repetitive loading is often invoked as potential driver of craniofacial morphology in hominins and other primates, but the dietary underpinnings of this behavior are not well understood. Food mechanical properties (FMPs), including toughness and elastic modulus, are known to influence certain aspects of primate feeding behavior, such as food selection. However, the exact role of FMPs in modulating masticatory patterns is unknown. Bone formation is regulated by high-magnitude stresses and/or cyclical loads, but there are few behavioral data on the dietary inputs generating different chewing patterns. It is consequently difficult to infer the respective roles of maximum versus repetitive loads in the development and evolution of the masticatory apparatus.

We tested the hypothesis that FMPs influence three key aspects of primate mastication: chewing frequency, chewing investment, and chewing duration. We sought to establish a link between FMPs and variations in chewing behavior by performing observational feeding experiments with captive primates from 21 species. Adults were provided with five food items of known FMPs. The subsequent feeding bouts were recorded with a high-speed camcorder, and video footage was analyzed to quantify chewing behavior. We performed intra- and inter-specific analyses to compare chewing parameters with FMPs and fragmentation indices.

Our results suggested that elastic modulus, rather than toughness, may be the determining factor in cyclical loading, potentially modulated by molar shearing crest height. Across species, chewing investment and duration increased in response to higher values for elastic modulus. This research has important implications for our understanding of hominin ecomorphology and dietary adaptations.

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Automated extraction of two-dimensional cortical porosity descriptors from histological and micro-computed tomography serial sections

MARY E. COLE and SAMUEL D. STOUT

Anthropology, The Ohio State University

Anthropologists have increasingly recognized cortical porosity as a metric of bone fragility, and health more broadly, both in archaeological and modern populations. However, manual measurement of individual pores on a cross-section is time intensive, and traditional slide preparation grinds away hundreds of micrometers of structural information. Serial sectioning is an alternative method of slide-making that creates distinct pore boundaries, which can then be automatically isolated by thresholding pixel intensity, particle size, and/or particle circularity with minimal near-automated correction. To demonstrate this potential for automated extraction, a right-side fourth rib from a 72-year-old female was processed into 1 mm of histological serial sections (thickness = 30 µm), and an immediately adjacent 10 mm of the rib was scanned with a Skyscan 1172-D High Resolution Desk-Top Micro-CT to produce digital serial sections (thickness = 4.88 µm). Pore boundaries were extracted in ImageJ and AvizoFire 8.1, respectively, and pore dimensions were reported by ImageJ. Average sectional pore mean area and percent porosity were similar between micro-CT (mean area = 0.00560 +/- 0.00262 mm^2; % porosity = 5.59 +/- 0.05%) and histological technique (mean area = 0.00444 +/- 0.000771 mm^2; % porosity = 5.71 +/- 1.9%). Micro-CT serial sections on average reported fewer, more circular pores (130 +/- 6.58 pores; 0.877 +/- 0.0132 circularity) than histological technique (167 +/- 8.98 pores; 0.709 +/- 0.050 circularity), as micro-CT can better incorporate tissue separating or edging pores. For both methods, adjacent serial sections can be interpolated to reconstruct the three-dimensional structure of the pore network.

Taxonomic distinction of two species of macaque (*Macaca mulatta* and *Macaca fascicularis*) through morphometric analysis of the os coxa

MARK A. CONAWAY, BRITTANY A. KENYON and NOREEN VON CRAMON-TAUBADEL

Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo-SUNY

Identification of phylogenetically relevant skeletal traits is a pervasive problem in bioanthropology, particularly when it comes to the history of our own species. Traditionally, crania have been considered the gold-standard in terms of phylogenetic relevance, but recent research has demonstrated the potential of postcranial elements, particularly the os coxa, for phylogenetic distinction at higher taxonomic levels (i.e. supra-generic). In the interest of challenging those limits, we test the hypothesis that two closely related, yet behaviorally distinct, species of macaque can be distinguished reliably based on pelvic morphology. A total of 20 landmarks were digitized on right os coxae of 20 adult *Macaca fascicularis* and 20 *M. mulatta* (10 male and 10 female of each species). Intra-observer error was calculated and returned an average standard deviation <1mm for three repeat trials on a single individual. Following generalized procrustes analysis, landmarks were analyzed using principal components analysis (PCA), canonical variate analysis (CVA), and discriminant function analysis (DFA).

Results of the PCA and CVA revealed interspecific shape differences in the angle of the superior and inferior pubic rami when comparing only females. Os coxa shape distinctions between males of each species were different to those seen in females and were much less clear using these methods. Results of the DFA (and accompanying cross-validation scores) corroborate those of the PCA and CVA with the addition of slightly more reliable interspecific distinction between males of the two species. Consequently, results provide partial support for the hypothesis with less reliable inter-specific distinction in males than females.

How do lowland gorillas hear?

MERCEDES CONDE-VALVERDE[1], IGNACIO MARTÍNEZ[1,2], MANUEL ROSA[3], ROLF M. QUAM[2,4,5], PILAR JARABO[3], ALEX D. VELEZ[4] and JUAN-LUIS ARSUAGA[2,6]

[1]Department of Ciencias de la Vida, Universidad de Alcalá, [2]Área de Evolución Humana, Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, [3]Department of Teoría de la Señal y Comunicaciones, Universidad de Alcalá, [4]Department of Anthropology, Binghamton University, [5]Division of Anthropology, American Museum of Natural History, [6]Department of Paleontología, Universidad Complutense de Madrid

Studying the auditory capacities in primates can provide valuable information on their sensory ecology and communication. This represents the first study on the auditory capacities in gorillas. We focused on: i) examining the influence of sexual dimorphism on the hearing in gorillas and ii) comparing the auditory capacities between gorillas and chimpanzees.We studied 21 crania of adult lowland gorillas (Gorilla gorilla). We reconstructed 3D virtual models of the outer and middle ear relying on high resolution CT scans and measured a series of anatomical variables that influence the transmission of sound power through the outer and middle ear between 0-5 kHz. We have also applied a detailed computer model, designed in the bioengineering literature and validated in chimpanzees and humans, to estimate their hearing patterns.Despite the large difference in body size between male and female gorillas, their hearing patterns are very similar. The only significant differences were found at 500 Hz, 1 kHz and 3 kHz (where females were more sensitive), although the differences were minimal.The hearing patterns are also very similar between gorillas and chimpanzees. The only significant differences were at 2 kHz and 3 kHz (where chimpanzees were more sensitive), and the magnitude of the differences was slightly larger than those found between sexes in the gorillas. Thus, the interspecific difference is greater than the intraspecific difference, despite the very high level of sexual dimorphism in gorillas. The hearing patterns between 0-5 kHz in gorillas and chimpanzees broadly resembles that of catarrhnies more generally.

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Vertical Climbing and The Plasticity of Motor Skills

K A. CONGDON and KRISTINA MERINO

College of Osteopathic Medicine, Touro University Nevada

Tetrapodal locomotion proceeded through a terrestrial phase before arboreality evolved. Understanding how terrestrial animals adapt to arboreality is crucial to understanding the origin of primates and their locomotor patterns. Arboreal animals must negotiate substrates of varying size and compliance, navigate gaps, move in X, Y and Z axes, and maintain balance while feeding. Determining how quickly a terrestrial animal can improve these skills will clarify questions regarding the origins of primate arboreality. Two cohorts of adult mice (n=12) – one conventionally housed, one housed in modified cages that required vertical climbing to access water, were tested on a Rotarod device every third day over a total study time of 6 months, with duration of maintained position recorded as a measure of motor skills. All animals were subjected to the same acceleration profile, in which speed of rotation increased consistently. Individuals were tested twice in succession, and the mean duration was calculated. Climbing animals remained on the Rotarod significantly longer than control animals (@2 seconds, $p<0.001$, $d=0.39$), showed early and continual improvement in their times across the duration of the study and maintained position through a rapid acceleration and directional change, indicating increased strength and balance. These results suggest adaptation to an arboreal environment is plastic, and can occur quickly in traditionally terrestrial animals. Future work will include morphological study of possible differences in the neurological and musculoskeletal anatomy of both cohorts, and expand the study to younger cohorts, longer time periods, larger samples, and tests for adaptation loss over time.

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Cranial shape change and developmental delays in plagiocephaly

CORTNEY M. CONNOR[1], SIERRA M.H. LEE[1], PINA S. SIMONE[1], CODY UPTON[2], LILLY W. TANG[1], DAKOTA A. DRAPER[3], GARY D. RICHARDS[3] and REBECCA S. JABBOUR[2]

[1]Department of Molecular and Cell Biology, University of California, Berkeley, [2]Department of Biology, Saint Mary's College of California, [3]Department of Biomedical Sciences, A.A. Dugoni School of Dentistry, University of the Pacific

Rates of unintentional deformation of infant crania are increasing, with reported rates as high as 48% in healthy infants. This appears to be related to changes in infant sleeping positions driven by the 1992 "Back to Sleep" campaign to combat SIDS. Long term developmental outcome studies associate this condition, called positional plagiocephaly, with developmental delays, possibly driven by impaired blood flow. To document the type and extent of change associated with positional plagiocephaly, we describe changes in cranial shape, brain shape, and blood flow patterns.

We CT-scanned dry skulls with evidence of positional plagiocephaly (n=5) and a series of normal infant skulls (n=10, ages 1-4.7 y). Amira was used to assess skull asymmetry from isosurfaces and to examine the endocranium and vascular system from surface models.

All affected infants display the typical pattern of occipitoparietal flattening and also show deformation of the auditory, optic, and temporal functional matrices. The frontoparietal regions show a 'copper-beaten' appearance resulting from increased intracranial pressure induced by an anterolateral shifting of the brain. Further, blood flow would have been impacted by observed bone displacement. Restriction of the carotid arterial system and cranial venous sinuses is evident. However, although all affected individuals share same-side flattening, the side on which vascular outflow is restricted varies. Observed changes to blood flow may be related to reported developmental delays; it is also possible the degree of asymmetry imposed on cranial functional matrices is of equal or greater influence.

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Dental indicators of *Paranthropus* tooth function

PAUL J. CONSTANTINO[1] and PETER UNGAR[2]

[1]Biology, Saint Michael's College, [2]Anthropology, University of Arkansas

Members of the genus *Paranthropus* have long been distinguished from other hominins by the presence of very large, flat postcanine teeth covered in thick enamel, though the function of this tooth morphology has been much debated. Many of the earliest researchers to study these hominins concluded that the teeth were adapted for breaking hard foods such as bone, nuts, or seeds, and a number of lines of evidence indicate that these teethwould indeed have been good at performing such functions and may have done so on occasion. However, studies of dental microwear and stable isotopes have indicated that at least one of these species, *Paranthropus boisei*, was not involved in the consumption of such foods. Instead, they appear to have been consuming mostly soft vegetable matter, despite the low, rounded cusps on their teeth that do not seem well-suited for such a task. *Paranthropus robustus*, on the other hand, has microwear and isotope signatures consistent with greater dietary diversity, including hard food items. In this presentation, we examine the evidence from tooth morphology, tooth fracture analyses, and dental microwear to provide the most up-to-date analysis of *Paranthropus* tooth function. We conclude that the members of the genus *Paranthropus* were not homogeneous in their feeding behavior and dietary ecology, and that their dental morphology may have served different functions in different regions of Africa.

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High-altitude adaptation in indigenous inhabitants from Western Himalayas

PALOMA S. CONTRERAS[1], SUDIPTA GHOSH[2], TOM BRUTSAERT[3] and ABIGAIL BIGHAM[1]

[1]Department of Anthropology, University of Michigan, [2]Department of Anthropology, North-Eastern Hill University, [3]Department of Exercise Science, Syracuse University

Human genetic adaptations to high altitude environments have been studied in different populations, especially indigenous inhabitants from the Andes and Western Himalayas. These studies contributed to the identification of multiple genes with strong signals of positive selection. However, the extent to which these adaptations converge in different populations remains unknown. The Monpas are an indigenous population from Arunachal Pradesh, in the North East of India. They have a long-term occupation of Eastern Himalayan Mountains, at 3800 m above sea level, and their genetic distance from surrounding populations has not been studied before. Here we study genome-wide SNP data genotyped using the BioBank array, from 49 Monpas from Tawang district. Our samples reveal to have minimum levels of admixture with other major continental populations, and also show genetic differentiation from Tibetans from the Western Himalayas. Our results provide insights into the genetic history of the Monpas, and suggest the possibility of finding distinctive signals of positive selection in this group. This study will contribute to a better understanding of the genetic mechanisms conferring adaptation to high-altitude environments.

University of Michigan

A comparison of lateral iliac flare measurement methods and their correlation with lesser gluteal moment arms

REBECCA W. COOK[1], GABRIEL S. YAPUNCICH[1,2], INDYA J. THOMPSON[1,3], CHRISTOPHER S. WALKER[1,2,4] and STEVEN E. CHURCHILL[2,4]

[1]Department of Molecular Biomedical Sciences, North Carolina State University, [2]Department of Evolutionary Anthropology, Duke University, [3]Department of Sociology and Anthropology, North Carolina State University, [4]Evolutionary Studies Institute, University of the Witwatersrand

Gauging the functional efficacy of the lesser gluteal muscles (*mm. gluteus medius* and *minimus*) is important for reconstructing hominin gait due to the role of these muscles in hip stabilization during the support phase of bipedal locomotion. One approach has been to quantify the degree of lateral iliac flare (i.e., angular deviation of the iliac blade from the sagittal plane), as increased flare should increase the leverage of the lesser gluteals by lengthening their moment arms. Due to inter- and intraspecific variation and fragmentary fossils, iliac flare has proven difficult to measure. Consequently, several measurement protocols have been developed. The compatibility of these protocols, however, has not been evaluated and their correlation with lesser gluteal mm. moment arms has not been assessed. Here we examine the relationships between four previously published methods for quantifying iliac flare and lesser gluteal mm. moment arms. Our sample includes 10 adult humans of varying ancestry, stature, mass, and sex. Three-dimensional models of the sacrum, innominate, and femur were generated with a structured light scanner and digitally rearticulated. Iliac flare was measured following the four published protocols, and the moment arms of the lesser gluteal mm. were determined digitally with the femur in a neutral position. There were few significant correlations between previously published measures of iliac flare and none of the measurements were significantly correlated with lesser gluteal mm. moment arms. The results of this pilot study suggest that the evaluated measures of iliac flare are poor indicators of lesser gluteal mm. leverage.

Macaque Attack: Dental topography through a wear sequence in *Macaca fascicularis*

SIOBHÁN B. COOKE[1,2], ANNA WISNIEWSKI[1], CLAIRE E. TERHUNE[3] and CLAIRE A. KIRCHHOFF[4]

[1]Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [2]New York Consortium on Evolutionary Anthropology, Morphometrics Group, NYCEP, [3]Department of

Anthropology, University of Arkansas, [4]Department of Biomedical Sciences, Marquette University

Primate molars are under strong selective pressure to maintain functionality while resisting the effects of abrasive foods and dietary grit. We examined changes in dental topography and occlusal area in a sample of *Macaca fascicularis* (N=75) left and right maxillary and mandibular first and second molars through a wear sequence. Measurements were taken on 3D models and included 1) total crown surface area above the CEJ, 2) 3D occlusal surface area, 3) dentin exposure, 4) 2D planar surface area, 5) maximum tooth length, and 6) relief index (3D surface area/ 2D planar surface area).

Dental relief decreases through the wear sequence, however, lightly worn teeth with small dentin exposures (<10% of occlusal area) had higher relief indices than unworn teeth in several individuals. This is likely due to increased occlusal surface area as a result of more complex occlusal topographies. Though relief index decreases over the wear sequence, 3D occlusal surface area does not decrease in a predicable manner. Some individuals with heavily worn dentitions and little surface topography displayed a similar total occlusal surface area relative to tooth length as individuals with unworn teeth – likely a result of the tooth increasing in width closer to the CEJ. While relief index and total occlusal surface area were nearly identical on the right and left sides of unworn and lightly worn denitions, these measures diverged through the wear sequence in some individuals; individuals with heavily worn teeth were asymmetrical. This asymmetry may have implications for movements across the TMJ.

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Pre-dispersal prospecting behavior and the solitary life-history stage: Examining neglected aspects of the dispersal process in socially monogamous owl monkeys (*Aotus azarae*)

MARGARET K. CORLEY[1], MARCELO ROTUNDO[2], VICTOR DAVALOS[3] and EDUARDO FERNANDEZ-DUQUE[1,2,3]

[1]Anthropology, Yale University, [2]Fundación E.C.O, Argentina Cecoal-Conicet, [3]Recursos Naturales, Universidad Nacional de Formosa

Dispersal is a key life-history stage that involves more than simply leaving the natal group. The complete dispersal process often entails a transient phase of movement before settling in a new area and may also involve exploring extra-territorial areas prior to permanently dispersing (i.e. prospecting). Male and female Azara's owl monkeys (*Aotus azarae*) often spend time ranging solitarily after dispersing. We utilized demographic data and *ad libitum* observations collected between 1997 and 2016 from a population of *A. azarae* in Formosa, Argentina to quantify the frequency of prospecting events and characterize the time spent ranging solitarily after dispersing. Thirty-six percent of individuals (21/58) that were captured and radio-collared while still in their natal group showed prospecting, with a larger proportion of females (43%, 13/30) than males (29%, 8/28) doing it, though this difference was not statistically significant (X^2=0.8, p=0.4). Most individuals (88%, 30/34) ranged solitarily for some time (mean: 5.4 ± 0.8 months, range: 0.5-14 months). Our results suggest that dispersal is an extremely variable process in owl monkeys. Both sexes follow a variety of strategies, which may involve prospecting and/or forming temporary associations with individuals outside of their natal groups before ultimately disappearing from the study area or finding a breeding position. Our data highlight the degree of heterogeneity among individuals within a single community and emphasize the need to consider all stages of the dispersal process.

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Systematic literature review of methods of study of hair cortisol in healthy children

JENNIFER CORONA and AMY L. NON

Anthropology, University of California, San Diego

A growing number of studies are measuring hair cortisol concentration as an objective estimate of chronic stress exposure. Hair cortisol can be valuable as a measure of stress in children because it is non-invasive and subjective survey measures can be difficult to collect in young children. However, few studies have analyzed hair cortisol in children to date, and it remains unclear whether hair cortisol is a reliable or stable measure of chronic stress across age groups. We conducted a systematic content analysis of all empirical studies in PubMed (n=20) that analyzed hair cortisol in healthy children (aged 1-18 years). We identified the most common trends in methods of hair collection, cortisol extraction, data analyses techniques, and the types of demographic (e.g. gender, age, ethnicity), environmental (socioeconomic status, maternal stress), and physiological (BMI, waist circumference) variables that were significantly associated with hair cortisol. Our results highlight the importance of standardizing modes of analyses of hair cortisol across studies in order to generate reproducible values and trends. For example, we found conflicting trends in associations between hair cortisol and age, indicating a need for further study. We conclude that more research is needed to establish reference ranges for healthy children, and to determine which types of demographic, environmental, or physiological variables associate with hair cortisol in healthy children. Once standardized, hair cortisol can be used as a consistent biomarker of stress across age groups, which may help identify children particularly vulnerable to chronic stress exposures.

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A reliable method to differentiate human from non-human fragmented shafts of limb bones using micro-computed tomography

BRIGIDA CORRIERI and NICHOLAS MARQUEZ-GRANT

Cranfield Forensic Institute, Cranfield University, Defence Academy of the United Kingdom

When fragmented bones are found in archaeological or forensic contexts, one of the first questions to address is whether or not they are human.

Limb bone shafts are commonly found, as their dense cortex eases a better preservation. Incomplete shafts can be challenging to identify as human, particularly when diagnostic landmarks are not visible. When bone is compromised, as many techniques as possible should be used, especially non-destructive methods as opposed to more invasive methods, such as histological analysis.

This study aims to demonstrate that micro-CT imaging can be an accurate non-invasive method to identify the human or non-human origin of fragmented diaphyses. Nutrient foramina and cross-sectional shape were considered as parameters.

A total of 61 human, sheep, deer, pig, chicken and duck limb bones were scanned. The micro-CT images were used to detect the cross-sectional shape of the shafts, the shape of the main nutrient canal entrance, and the angle at which the canal enters in the bone.

Human nutrient foramina were significantly different from the non-human ones; the canal entrance shape was particularly effective for the human/non-human differentiation. Furthermore, human limb bones showed specific cross-sectional shapes not seen in other mammals or in birds.

This study provides an important contribution, as it demonstrates that cross-sectional shape and nutrient foramina are reliable features to differentiate human from non-human fragmented limb bones, and that micro-CT scanning is a suitable method for non-invasive bone origin identification. This is applicable to a number of archaeological contexts and forensic scenarios.

Intraspecific variation in limb bone strength in *Pan troglodytes* and *Gorilla gorilla*

MIRANDA N. COSMAN[1], STEPHEN SCHLECHT[2], KARL JEPSEN[2], LAURA MACLATCHY[1] and MAUREEN DEVLIN[1]

[1]Anthropology, University of Michigan, [2]Orthopaedic Surgery, University of Michigan

Intraspecific phenotypic variation is the result of the relationship between skeletal plasticity and genetic constraint. Skeletal plasticity includes osteogenic responses to mechanical loading, with different modes of locomotion resulting in varying cross-sectional shapes. While such patterns have been studied in detail across primates, the extent of postcranial intraspecific variation within primates is largely unknown.

We ask: Are there differences in patterns of postcranial variation in limb bone strength in *G. gorilla* and *P. troglodytes*? Data were collected from adult *Pan* (19 males, 34 females) and *Gorilla* (46 males, 29 females) from the Hamann-Todd Osteological Collection. The humerus, radius, femur, and tibia of each individual were pQCT scanned at 50% midshaft, and linear measurements were recorded. We used coefficients of variation and Levene's tests to assess variance differences within each bone between sexes of a single species, and between a single sex of both species. *Gorilla* were more variable in their cross-sectional properties than *Pan*. The shape (Imax/Imin) and strength (J) of *Gorilla* males were significantly more variable than *Pan* males in all bones ($p<0.05$). *Gorilla* females were consistently more variable than *Pan* females across all bones in strength (J) but not shape (Imax/Imin). Sex-specific patterns of variation also differed between *Gorilla* and *Pan*. *Pan* females were more variable in humeral and tibial shape relative to males, but *Gorilla* females were significantly more variable in all bones. These results show site specific differences between and within species and sexes, suggesting that the interaction between genetic constraint and skeletal plasticity is complex.

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Subsistence and land space use in the South Caucasian Late Bronze Age and Iron Age: A comparison of three regions using $\delta^{13}C$ and $\delta^{15}N$ isotopic analysis of skeletal remains

ISABELLE COUPAL

Anthropology, University of Montreal

The study of Caucasian prehistory has traditionally relied heavily on material culture for new discoveries, but bioarchaeology and biogeochemical methods are emerging as a promising avenue to test existing hypotheses and create paths for new research. Stable isotope analysis of skeletal remains can give us valuable information about diet in ancient populations when artifacts are scarce. This research is an interregional comparison of Late Bronze and Early Iron Age period of South Caucasian communities on the question of dietary subsistence and settlement patterns. 61 samples of human and animal (ovicaprid, cattle, pig) bone and teeth were chosen from various sites in three ecoregions of the South Caucasus (Tsalka plateau – Georgia; Ararat valley – Armenia; Sevan Lake basin – Armenia), 26 of which contained sufficient collagen and were analysed for $\delta^{13}C$ and $\delta^{15}N$ stable isotopes by mass spectrometry. Results show enriched $\delta^{13}C$ and $\delta^{15}N$ values in Tsalka Plateau and Sevan Lake Basin human groups. This indicates the consumption of C_4 pathway plants, although such crops are not adapted to these climates, and a high dependence on meat or meat-based products for subsistence. A non-parametric test distinguished two groups of herbivores in the Ararat Valley based on $\delta^{13}C$ values ($p=0.023$). This is attributed to different herding strategies amongst locally raised domesticates. These results, in conjuncture with existing paleoenvironmental research, will be used to explore the possibility that grain commerce was practiced in the emerging Iron Age states.

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Some colobines do swing; douc suspensory behavior and anatomy

HERBERT H. COVERT[1], CRAIG D. BYRON[2], MICHAEL C. GRANATOSKY[3] and CATHERINE WORKMAN[4]

[1]Anthropology, University of Colorado Boulder, [2]Biology, Mercer University, [3]Organismal Biology and Anatomy, University of Chicago, [4]Wildlife and Wild Places, National Geographic Society

In the 1960s Old World semibrachiation was formalized as a locomotor category comprised by the Colobinae. In the following decades research conducted on the positional behavior of a variety of colobines revealed that these creatures rarely, if ever, used forelimb suspension. Thus, this locomotor category was largely dismissed by the 1990s. Here we review behavioral observations, skeletal anatomy, and mechanical analysis of the douc monkey (genus *Pygathrix*) documenting that some colobines are adapted for forelimb suspensory locomotor and postural behavior. We initially documented that adult doucs were intermediate between quadrupedal colobines (genus *Trachypithecus*) and suspensory gibbons (genus *Nomascus*) in suspensory behaviors. We next documented that immature doucs use significantly more suspensory locomotor and postural behaviors than immature members of *Trachypithecus.* This led us to hypothesize that the forelimb anatomy of doucs would differ from that of *Trachypithecus* in being characterized by features associated with suspensory behavior; which was confirmed by study of a large sample of primate skeletons. Finally, kinetic and kinematic analyses demonstrate that during forelimb suspension, doucs mechanically resemble spider monkeys and gibbons in limb loading and movement while differing in wrist postures. While we do not see utility in resurrecting the Old World semibrachiation locomotor category it is important to realize that some colobines do frequently forelimb suspend. This research is fitting for a symposium honoring Dr. Richard Kay, a scholar that has long appreciated the importance of combining behavioral observations, comparative anatomical studies, and experimental analyses for understanding primate adaptation and evolution.

Malaria in the prehistoric Caribbean: The hunt for hemozoin

MALLORY D. COX

Anthropology, University of Louisville

This research tests the theory that, contrary to current research paradigms, malaria was introduced to the Americas thousands of years before European contact in the late 15th century. This theory is supported by analyses of certain factors regulating the introduction, maintenance, and transmission of malaria in human populations. When viewed holistically, skeletal, paleoenvironmental, archaeological, and historical data suggest the existence of a chronic, non-lethal strain of malaria, such as *Plasmodium vivax*, in the prehistoric Americas. Newly developed methods aid archeologists in identifying evidence of malaria in ancient skeletal remains. One such method is via the biomarker hemozoin. Hemozoin is an insoluble, crystallized pigment, that sequesters and is preserved in bones of individuals infected with malaria, as well as two other tropical parasitic infections: *Schistosoma mansoni*or 'schistosomiasis' and *Rhodnius prolixus*or 'Chagas'. Each species of hemozoin-producing parasites demonstrate uniquely shaped crystals, differentiated at the microscopic level using Scanning Electron Microscopy. To test for evidence of malaria in prehistoric Caribbean remains, I sampled 30 skeletons at Yale's Peabody Museum of Natural History, and performed analyses using Matrix Assisted Laser Desorption Time-of-Flight Mass Spectrometry. Preliminary results indicated molecular signatures for hemozoin in a sample from an adult female, recovered under 'Santa Elena' ceramics (890 CE-1210 CE) at the site of Toa Baja in Puerto Rico. These preliminary results will be refined by future sampling and replication of analysis. Ultimately, this project has the potential to further elucidate when, where, and how *vivax* malaria was introduced to human populations.

Predictors of age at first reproduction in adolescent female rhesus macaques

SEAN P. COYNE

Psychology, Notre Dame of Maryland University, Institute for Mind and Biology, The University of Chicago

Age of first reproduction is a critical factor that influences lifetime reproductive success. In female primates, there are a variety of factors that can affect the timing of menarche and subsequently age of first reproduction. Previous work has demonstrated that about 33% of variation in age of first reproduction is explained by parental rank, birth order, seasonal effects and heritability, leaving a large portion of the variation in age of first reproduction explained by unknown environmental factors. This study investigated effects of early life adversity, and its relationship with cortisol, on age at first reproduction. Subjects were 22 females from a birth cohort of rhesus macaques (*Macaca mulatta*) on Cayo Santiago from which mating behavior and non-invasive hormone samples were collected. Results indicate that experiences of early life adversity had no effect on cortisol levels (LMM: $F[2,19.163] = 0.731$, $p = 0.494$). Further, early life adversity did not influence age at first reproduction (Kruskal-Wallis = 0.017, df = 2, $p = 0.991$). However, both dominance rank (Chi-squre = 10.05, $p < 0.01$) and latency to cycle in the season (Kruskal-Wallis = 7.682, df = 2, $p = 0.021$) significantly affected age of first reproduction. Due to seasonal changes in food availability immediately prior to the mating season, greater access to nutritional resources by females of high rank may be what moderates the rank related differences in age of first reproduction. This study furthers our understanding of the factors that influence age of first reproduction in female primates.

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The interplay of behavioral and occlusal etiologies in aberrant tooth wear

ADAM CRANE[1], JAMES T. WATSON[1] and RANDY HAAS[2]

[1]School of Anthropology, University of Arizona, [2]Department of Anthropology, University of California, Davis

Detailed investigation of tooth wear can provide information about diet, food preparation, pathology, idiosyncratic behaviors, and occupational activities. The application of standard scoring approaches however, obfuscates the wide variety of aberrant wear observable within and across populations. Tooth wear begins from multiple etiologies (i.e. attrition, erosion, abrasion, abfraction) but cascades into complex inter-connected relationships that vary across the arch and between jaws. Wear resulting from one etiology may cause changes in occlusion that affect the manifestation of other forms, thus the analysis of aberrant wear cannot be undertaken without first parsing relationships among co-occurring etiologies. While such interactions may complicate problem-oriented studies of tooth wear, the complex intermingling of wear types reflects the particular value of teeth as a site for holistic interpretations of embodiment (e.g. of subsistence and other cultural activity). Here, we develop a model of aberrant tooth wear that assesses both proximate (e.g. attrition, erosion, etc.) and ultimate etiologies (i.e. behavioral vs. occlusal) through the description of wear in terms of dentition, tooth class, tooth surface, and wear morphology. The goal of this model is to apply a systematic approach to the analysis of aberrant wear, such that the varied cultural phenomena embodied in the teeth can be defined with greater clarity. After outlining the model, we briefly explore its utility through a case study of early foragers from the Lake Titicaca Basin in southern Peru.

A biocultural approach to reconstruct immune competence in past populations: searching for a new dialogue between immunology and bioarchaeology

FABIAN CRESPO

Department of Anthropology, University of Louisville

Inflammation is an adaptive response, and significant progress has been made when understanding local inflammatory reactions induced by infection or tissue injury; but much less is known when understanding causes and consequences of systemic inflammation. Traditionally, in most bioarchaeological studies, inflammatory processes were correctly studied at the local level on different bone lesions or alterations. However, evidence is building that we need to understand the unexpected systemic consequences of local inflammatory processes. That is, a local inflammatory microenvironment can impact distant tissues. The inflammatory phenotype (IP) of an individual is a reflection of its evolutionary, environmental, and social history; where different factors (biotic and abiotic) play a significant role in constantly reshaping the immune system. Initially, we conducted different *in vitro* experimental protocols to analyze how different inflammatory inducers can generate a shift in the immune response produced by human immune cells, exploring how local immune responses could affect distant inflammatory process, mostly associated with local infections. However, humans are immersed in complex and heterogeneous biosocial landscapes, making extremely difficult the extrapolation of most *in vitro* experimental results. Bioarchaeology has a unique opportunity to help in such extrapolation and in the reconstruction of IP when studying different skeletal markers where inflammation is involved; a reconstruction that could produce a "skeletal inflammatory index." We propose a multifactorial model when reconstructing IP and immune competence in past populations; a model that considers the generation of a new theoretical and practical framework including disciplines such as bioarchaeology, osteoimmunology, and ecological immunology.

Geometric morphometric analyses of changes in craniofacial and anterior cranial base shape

SANDRA CRIDLIN

Anthropology, University of Tennessee, Knoxville, Medical Assisting, South College

Studies have identified that the cranial vault has become taller and narrower, and mandibular breadth has decreased but increased in length over the past 150 years among Americans. The skull, as a complex of integrated elements, has regionally differing patterns and trajectories of ontogenetic formation and development. To maintain functionality, expansional growth necessitates accommodation and cooperation among individual elements and the regions they comprise. Therefore, a reasonable hypothesis is that concomitant changes in facial and anterior cranial base shape have accompanied the aforementioned changes in the vault and mandible. This study identifies secular changes in craniofacial and anterior cranial base morphology in White American males and females.

Data for this study consisted of 21 digitized craniometric landmarks obtained from n=662 individuals with birth years spanning 1840-1990. Generalized Procrustes Analysis (GPA) was used to fit these three-dimensional coordinate data into a common coordinate system to ascertain differences in shape. Shape scores obtained from the GPA regressed onto birth year revealed statistically significant morphological changes have occurred over time ($p<0.0001$). Shape score and interlandmark distance correlations identified specific landmarks associated with secular increases in both anterior cranial base length and facial projection, and decreased facial breadth. Canonical variates analysis confirms the presence of this shape change trend in both sexes. Results of the present study are in accord with previously identified changes in cranial vault and mandibular morphologies. All of these findings combined indicate the cranium is becoming more dolichocephalic over time which is also a trend observed in other populations.

Hadza hunter-gatherer diet: chemical composition of foods and estimate of food type contribution

ALYSSA N. CRITTENDEN[1], NANCY L. CONKLIN-BRITTAIN[2], J. COLETTE BERBESQUE[3], BRIAN M. WOOD[4,5], AUDAX Z. MABULLA[6] and MARGARET J. SCHOENINGER[7]

[1]Anthropology, University of Nevada, Las Vegas,

[2]Human Evolutionary Biology, Harvard University, [3]Centre for Research in Evolutionary, Social and Inter-Disciplinary Anthropology, University of Roehampton, [4]Human Behavior, Ecology and Culture, Max Planck Institute for Evolutionary Anthropology, [5]Anthropology, University of California, Los Angeles, [6]Archaeology and Heritage, University of Dar es Salaam, [7]Anthropology, University of California, San Diego

Changes in diet composition during our evolutionary past are routinely associated with watershed moments, such as tool making, brain expansion, family formation, cooperation, and increased longevity. Fundamental to this discussion is the diet composition of contemporary hunters and gatherers. Here, we report chemical composition data for 11 species of Hadza plant foods, including analysis of fat, crude protein, free mono- and disaccharides, fiber (neutral-detergent fiber), and ash. Total non-structural carbohydrates were determined by difference. Energy values (total kilocalories) were determined for each food based on the potential energy contribution of the above listed nutrient fractions. Energy was calculated using 4 kcal/g dry matter (DM) for protein and total non-structural carbohydrates and 9 kcal/g DM for lipids. We report chemical values expressed as a percentage of the DM of each food and as a percentage of the organic matter (OM). We then estimated the contribution of kilocalories of each food type (plant and animal) to the Hadza diet using a sample of 8112 food returns collected between 1995-2005. Our results suggest that animal products (including meat and honey) contribute 43% and plant foods contribute 57% (including 3% domesticated species) to the in-camp diet. These data represent the first estimate of Hadza diet using lab generated chemical values and OM (as eaten) estimates of field measured foods, making them valuable in providing a summary of Hadza diet across seasons. As the Hadza continue to consume more domesticated cultigens, data that report on a predominantly wild diet, before nutrition transition, are critical.

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An imperfect science: Lessons for cross-disciplinary dialogue and public advocacy from the March for Science Boston

ELIZABETH T. CROCKER

Dialogue on Science, Ethics, and Religion (DoSER) and American Association for the Advancement of Science (AAAS)

Scientists are increasingly interested in lending their voices and expertise to national discussions in the public sphere about science, technology and society. Topics at the intersection of science and society include research funding decisions and broad research directions, STEM education, and who gets a voice in, and benefits from, new scientific advances and applications. Scientists and scientific institutions are also interested in issues that impact the ability to conduct and apply scientific research. However, the nature of this engagement and where the borders of science are with relation to social and political issues are heavily debated. Many scientists also lack experience in engagement with culturally diverse publics.

This auto-ethnographic talk uses the March for Science Boston as a case study to explore how these dynamics play out in three related dimensions. First, it explores how social media amplifies and complicates divisions and agendas with relation to science engagement- both among publics and within the sciences, especially related to issues of improving science from within. Second, it examines how science advocacy and the interests of faith communities intersect in public spheres, and their potential to be supportive collaborators. Third, it looks at tensions surrounding non-partisan science advocacy in a highly polarized socio-political climate. It concludes with takeaways about how anthropological lenses can aid constructive public science advocacy.

Determining the non-human bone fragments most commonly confused with human remains: indications for forensic anthropological training

SARAH L. CROKER and DENISE DONLON

Discipline of Anatomy and Histology, Sydney Medical School, University of Sydney

In forensic anthropology and bioarchaeology, distinguishing between human and non-human skeletal remains is the critical first step. Previous work analysing anthropological cases from 2008 to 2016 at the Department of Forensic Medicine (DOFM), Sydney, Australia, revealed that non-human cases actually comprise a significant majority of the caseload. Many of these bones are not difficult to identify with only brief training, so if non-experts could learn the most common bones, this could result in a more efficient use of resources. To determine the focus of such training, all non-human bone cases presented to the DOFM from 2015 and 2016 were analysed by identifying as many fragments as possible from the photographs of each case. Seventy-one cases contained 1216 bones and fragments in total, of which 680 (55.9%) could be identified from the photographs. The most numerous fragments were from sheep: vertebrae (12.9% of identified fragments), ribs (7.8%), femora (6.0%) and tibiae (5.8%); followed by cattle vertebrae (5.2%). Sheep femora and tibiae appeared in the greatest number of cases (26.8% and 22.5%). Only three cases contained skull fragments and teeth, possibly reflecting a better public knowledge of skull anatomy. The types of bones indicate not only a general similarity in size to human bones, but patterns of meat consumption, hence may potentially differ between regions. By knowing which fragments are most commonly encountered, efficient training can be provided for those in contact with bones. This could assist in triaging disaster victim identification, and allow experts to be utilised where most needed.

Integrated macroscopic and isotopic analyses to examine 'stress' during periods of political transition in Transylvania, Romania

KAYLA D. CROWDER[1], JANET MONTGOMERY[1], CHARLOTTE A. ROBERTS[1], DARREN R. GRÖCKE[1,2], MIHAI GLIGOR[3] and NYARADI ZSOLT[4]

[1]Archaeology, Durham University, [2]Archaeology, Stable Isotope Biogeochemistry Laboratory, [3]Archaeology, Universitatea 1 Decembrie 1918 din Alba Iulia, [4]Archaeology, Haáz Rezső Múzeum

The term 'stress' can be used to discuss a myriad of factors in bioarchaeology. For this research, the term stress will be used to discuss skeletal lesions commonly associated with metabolic/nutritional inadequacy. This study integrates isotopic and macroscopic skeletal analyses to examine the link between 'stress' and discrete periods of political transition within the Carpathian Mountain Basin of Transylvania, Romania. The Iclod Necropolis has been associated with Late Antiquity and was under occupation when multiple barbarian tribes sought power during the post-Roman transition. The individuals buried at the Bögöz Church and Fenyéd cemetery have been dated to the Arpadian transition (Middle Ages) and are thought to be among the first Hungarian settlers in this region. The hypothesis, that both populations would exhibit a high prevalence (>50%) of skeletal markers commonly associated with 'stress,' was confirmed using macroscopic skeletal analysis. Stable carbon and nitrogen analysis was conducted on incrementally sampled dentine to assess the possible effect insults during development had on one's ability to thrive during documented periods of conflict [non-adults (range $\delta^{13}C$: -21.1 to -15.6‰, $\delta^{15}N$: 7.5-14.5‰), young adults (range $\delta^{13}C$: -20.9 to -15.5‰, $\delta^{15}N$: 9.0-15.7‰) and middle/older adults (range $\delta^{13}C$: -22.9 to -11.6‰, $\delta^{15}N$: 8.4-15.2‰)]. Early-life profiles will be analyzed on individual and population levels.

Strontium and oxygen isotope analyses are currently being employed to determine if individuals with local childhood values have fewer 'stress indicators' than those with non-local childhood values. This research will aid our understanding

of how people lived and died during political unrest in Transylvania.

We are grateful to Stable Isotope Biogeochemistry Laboratory, Institute of Medieval and Early Modern Studies, Rosemary Cramp Fund, and University College, Durham University for helping to fund this research.

Using strontium isotopes to track spatial patterns in depredation of lemurs by endemic goshwaks at Ranomafana National Park

BROOKE E. CROWLEY[1], SUMMER J. ARRIGO-NELSON[2], ANDREA L. BADEN[3,4,5] and SARAH M. KARPANTY[6]

[1]Departments of Geology and Anthropology, University of Cincinnati, [2]Department of Biological and Environmental Sciences, California University of Pennsylvania, [3]Department of Anthropology, Hunter College of the City University of New York, [4]Departments of Anthropology and Biology, The Graduate Center of City University of New York, [5]The New York Consortium in Evolutionary Primatology (NYCEP), [6]Department of Fish and Wildlife Conservation, Virginia Tech

Apex predators play critical roles in the ecosystems they inhabit. Unfortunately, little is known about spatial patterns in mobility or foraging for most species. This information is critical for evaluating their potential impact on prey species as well as the adequacy of existing or proposed protected areas. Strontium isotope ratios ($^{87}Sr/^{86}Sr$) in prey remains reflect the geology where predated individuals lived, and can be used to identify predator foraging patterns. We used $^{87}Sr/^{86}Sr$ in consumed lemurs to reconstruct foraging ranges for Henst's goshawk (*Accipiter henstii*) at Ranomafana National Park (RNP), Madagascar. We analysed remains from 19 depredated *Avahi peyrierasi*, *Microcebus rufus*, *Cheirogaleus* spp. recovered from four hawknests along the eastern edge of RNP and foliage from plants growing on the two primary geologies in the region: Precambrian migmatite, which underlies lower elevations in eastern RNP and Precambrian metasediments, which underly higher elevations in western RNP. $^{87}Sr/^{86}Sr$ is lower for foliage from migmatite and 18 of the lemurs have $^{87}Sr/^{86}Sr$ consistent with migmatite. These results suggest that goshawks primarily forage at lower elevations in eastern RNP, which is consistent with previous observations that goshawks rarely forage outside of forest or at elevations >1200 m. Given their patchy use of habitat, raptor populations might be overestimated by park sizes. Moreover, they may disproportionately affect lemurs at lower elevations in protected areas and unprotected fragments, which has important management implications. Isotopic analysis of prey is a non-invasive method for monitoring predator foraging patterns that is readily adaptable to other systems and species.

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Bioarchaeological and odontological perceptions of "oral health" in Mexican populations

ANDREA CUCINA[1], ELMA M. VEGA LIZAMA[2] and MARCO A. RAMIREZ SALOMON[2]

[1]Facultad de Ciencias Antropologicas, Universidad Autonoma de Yucatan, [2]Facultad de Odontologia, Universidad Autonoma de Yucatan

The Mexican Dental Association (MDA) has adopted the concept of oral health expressed in September 2016 by the Fédération Dentaire Internationale. "Oral health is a very complex and multifaceted definition that includes concepts like smiling, talking and transmitting emotions … without pain, discomfort or diseases". In particular, pain and discomfort are those elements that alert individuals of their unhealthy oral conditions, and lead them to seek medical attention. Grade 1 caries, scored by dentists but not by bioarchaeologists, are asymptomatic; it means that they do not generate the pain or discomfort that characterize unhealthy conditions. This analysis focuses on carious lesion (calculated by means of DFM teeth) in a modern population from Yucatán ranging from 1 to 88 years of age. Results indicate that 17.1% of the sample (59/345), with age ranging from 1 to 79 years of age, are caries free. Ninety-nine individuals (from 3 to 88 years old) present one to 10 grade 1 caries; however, only 13 people are affected by just a grade 1 caries, which raises the number of individuals showing no symptoms to 72 (20.9% of the whole sample). The remaining 79.1% of the sample, regardless of age or sex, has experienced at least once in his/her lifetime some caries-related condition(s) that likely produced pain or discomfort. With only one out of five people free from caries-induced painful conditions, Yucatán, according to the standards set forth by the FDI, has been experiencing "oral health" issues that require more careful health policies by the MDA

Morphological integration of hyoid and skull through ontogeny in *Macaca mulatta*

ANDREANA S. CUNNINGHAM and VALERIE BURKE DELEON

Anthropology, University of Florida

The skeletal framework for the vocal tract in non-human primates provides a functional model for interpreting differences in vocal behavior. Previous studies have shown that ontogeny substantially influences vocal tract morphology, but this work has focused primarily on the position of the larynx rather than on the structure of the hyoid as it relates to the skull. This study used 3D geometric morphometrics to evaluate the effects of ontogeny, sex, and matriline on hyoid growth, as well as morphological integration between the hyoid and skull in *Macaca mulatta*. The sample included 155 *Macaca* skeletal specimens housed at University of Puerto Rico Caribbean Primate Research Center, representing both sexes and ages from 2-25 years old.

Landmark coordinate data capturing shape of cranium, mandible, and hyoid were collected from each specimen using a MicroScribe. Data were aligned with a generalized Procrustes superimposition, and shape was tested with PCA, ANCOVA, and PLS 2-Block analyses. The results indicated a strong relationship between hyoid growth and ontogeny. Juvenile hyoids were lengthened anteroposteriorly in relation to adult hyoids. ANCOVA indicated a significant relationship between PC1 score and age and matriline, respectively, but not sex. Interactions of age with sex and matriline were non-significant. PLS 2-Block analyses showed significant morphological integration between cranium-hyoid and mandible-hyoid. These results demonstrate that hyoid shape changes during growth, and suggests an impact of matrilineal separation on hyoid morphology. The strong morphological integration suggests that the hyoid constitutes a more diagnostic component of the vocal tract complex than has been previously understood.

Estimating body mass in *Homo erectus* using the talus

DEBORAH L. CUNNINGHAM[1], MELINDA V. ROGERS[1], DANIEL J. WESCOTT[1] and ROBERT C. MCCARTHY[2]

[1]Anthropology, Texas State University, [2]Biological Sciences, Benedictine University

Compared to contemporaneous fossils, the ~1.6-Ma hominin talus KNM-ER 5428, provisionally assigned as a male to *H. erectus,* is large. Boyle and DeSilva (2015) estimated a body mass greater than 90 kg based on a 33.7 mm mediolateral (ML) breadth at the midpoint of the talar trochlea using the average of McHenry's (1992) three human regression equations. These values are three standard deviations greater than McHenry's (1992) means, suggesting that the fossil measurement and body mass estimate are extrapolations beyond the data. We performed a two-fold analysis. First, we examined the variation in talus ML breadth in a male modern human sample of known body mass (n = 78). Second, we compared the talus ML measurement with femoral head breadth (FHB), an accepted proxy for body mass, using a worldwide human sample including both large- and small-bodied individuals. After controlling for obesity, the body masses of individuals with a talus measurement 33.2 mm or greater (33.2 - 36.7) ranged between

67.1 and 87.1 kg. The correlation between talus ML breadth and FHB is moderate (R^2 = 0.6) in a worldwide sample of males, suggesting considerable variation between FHB and talus ML breadth dimensions. We suggest that there is substantial evidence that KNM-ER 5428's body mass could have been less than 90 kg.

A comparison of metric variation in deciduous molars of *Homo sapiens* and *Homo neanderthalensis*

ANGELINA CURLEY[1] and SHARA BAILEY[2,3]

[1]Department of Ecology, Evolution, and Environmental Biology, Columbia University, [2]Center for the Study of Human Origins, New York University, [3]New York Consortium in Evolutionary Primatology

Although fewer in number, smaller in size, and less mineralized than their permanent successors, deciduous teeth comprise a significant portion of the paleoanthropological record. At some sites individuals are represented only by the deciduous dentition. Continued study of variation within and among species is important for understanding the taxonomic valence of crown traits. This study compares variation in buccolingual and mesiodistal measurements of deciduous molars. Of particular interest are whether or not Neanderthals and *Homo sapiens* share a pattern of size variation and which group shows greater variation in crown dimensions. The samples included 479 upper and lower deciduous first and second molars from early *Homo sapiens* (n=12), Neanderthals (n=44), Upper Paleolithic *H. sapiens* (n=27), and recent *H. sapiens* representing a wide range of geographic regions (n=396). Coefficients of variation (CV) were calculated to compare variation among *H. sapiens* fossil and extant groups, between *H. sapiens* and Neanderthals, and across geographic samples of recent humans. The results were mixed. In *H. sapiens*, *contra* previous studies, the dm2 was more variable in length and breadth measurements than was the dm1. However, in Neanderthals the opposite was true (dm1 was more variable). Although represented by vastly different chronological samples and geographic regions, the range of CVs in *H. sapiens* (5.7%-6.7%) was smaller than that of Neanderthals (3.4%-9.3%). Interestingly, however, the relationship between mesiodistal and buccolingual dimensions was stronger in Neanderthals than in *H. sapiens*. Across geographic regions, the range of CVs was largest in the Americas (3.2%-7.3%) and smallest in Europe (4.6%-6.2%).

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A mechanobiological perspective on the facial skeleton of *Paranthropus*

DAVID J. DAEGLING

Anthropology, University of Florida

Robust australopiths are exceptional in terms of the hypertrophy of the gnathodental complex, which has led to much speculation concerning their feeding behavior and dietary adaptations. Consensus has proven elusive, and one point of argument is whether durophagy explains the unique facial skeleton in *Paranthropus robustus* and *P. boisei*.

Durophagous analogies for *Paranthropus* exist among living primates, although these ultimately fail as explanations since one never observes convergence of robust australopith facial proportions with living primates. The fact of hard-object specialists among living primates, however, leads to the conclusion that the robust australopith face is sufficient but not necessary for processing a durophagous diet.

One alternative dietary scenario for East African *Paranthropus* is the bulk processing of relatively tough, but not necessarily hard, foods. Behavioral and experimental evidence from living primates indicates that such a diet induces moderate levels of bone strain but requires an elevated number of chewing cycles over the course of daily feeding.

Experimental work has established that the interaction between strain magnitude and load frequency instigates increases in bone mass. Both high strain, low frequency events and lower strain, high frequency events may evoke similar morphological responses. Given the possibility of either scenario, the particulars of feeding behavior are not recoverable from facial morphology. The facial architecture of *Paranthropus* probably elevated the importance of shear stresses over normal stresses during feeding. This change may have altered the selective value of different skeletal properties (e.g., strength, fatigue life) during the evolution of this genus.

The role of political, economic, and biocultural processes in producing sexual dimorphism and health disparities in recent human populations

ASHLEY C. DAFOE, MARY C. MCALPINE and MOLLY K. ZUCKERMAN

Department of Anthropology and Middle Eastern Cultures, Mississippi State University

Sexual dimorphism in modern human populations is often attributed to selective processes related to mating, reproduction, and competition over resources, much as it is interpreted within non-human primates, both fossil and extant. However, when considered relative to the complex socio-political and economic factors involved in the construction of gender roles and sexual politics, this explanation emerges as reductive and simplistic. Here, we explore the role of socio-political, economic, and biocultural processes in contributing to sexual dimorphism in recent human populations. We ask: when does gender inequality produce or contribute to sexual dimorphism? To do this, we adopt a definition of sexual dimorphism that encompasses skeletally visible, population-level variables. These include: overall health and experiences of stress (frailty); trauma (fractures); stature; disease frequency; mortality (age at death); and pubertal timing (pubertal growth spurt, menarche); and diet (isotopic evidence of protein access). We conducted an ongoing review of papers (N≥50) published in the past c. 25 years documenting a range of differences in these variables within Holocene-era skeletal assemblages relative to skeletally estimated sex and reconstructed gender. We derive a set of general, flexible, culturally contingent parameters useful for analyses of skeletal assemblages that potentially enable identification of circumstances wherein sex- and gender-based differences in the above variables can be attributed to gender inequality. Preliminary results include identification of the parameter of detection of significant sex- or gender-based differences in protein consumption (via δ15N signatures), particularly during the juvenile and reproductive periods, as evidence of sexual dimorphism potentially produced through gender inequality.

Health and Lifestyle of the Paleoamericans of Lagoa Santa, Central-Eastern Brazil

PEDRO DA-GLORIA

Department of Genetics and Evolutionary Biology, University of São Paulo

Lagoa Santa is an archaeological region of Central-Eastern Brazil which has a long history of research that dates back to the 19th century. Since then, hundreds of human skeletons were found in deposits dated to the Early Holocene (10,000 to 7,000 yr. BP), making this region unique for studies of early hunter-gatherers in the Americas. Inspired by the bioarchaeological approach outlined by Clark Larsen, we undertook an investigation of five aspects of biocultural adaptation at Lagoa Santa: oral health, physical activity, infectious diseases, stress during growth and development, and interpersonal violence. We compared the Lagoa Santa sample (n=195) with the Western Hemisphere database, which is composed of 6,733 prehistoric skeletons from 36 samples of foragers and farmers. We hypothesized that Lagoa Santa would show few osteological markers of stress and diseases, as is typical of hunter-gatherer populations worldwide. The results indicated that Lagoa Santa inhabitants had a relatively high consumption of carbohydrates (high prevalence of caries), lived in relatively dense and aggregated groups (high

prevalence of systemic infections), and suffered from multiple stresses (nutritional, infectious, and social). These unexpected results seem to be due to a tropical environment where the abundance of plants resources was high, and the foraging area was more restricted. Archaeological findings showing evidence of plant processing and year-round occupation of the rockshelters corroborate these results. This study is the first comprehensive analysis of Paleoamericans' health and lifestyle, and it was only possible by the guidance of Clark Larsen and the application of a bioarcheological approach.

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Sex Differences in Oral Health at the Greek Colony of Himera

ERIKA B. DANELLA[1,2], BRITNEY KYLE[3], LAURIE J. REITSEMA[4], STEFANO VASSALLO[5], PIER FRANCESCO FABBRI[6] and CHELSEA BATCHELDER[4]

[1]Department of Biological Sciences, Quinnipiac University, [2]Department of Sociology, Criminal Justice, and Anthropology, Quinnipiac University, [3]Department of Anthropology, University of Northern Colorado, [4]Department of Anthropology, University of Georgia, [5]Archaeological Heritage Section, Regional Archaeological Superintendence of Palermo, Italy, [6]Department of Cultural Heritage, Università del Salento

In the archaeological record, females tend to have worse oral health than males due to differences in diet, resource availability, and/or social position; there are also possible biological factors that negatively influence female oral health. This study examines potential inequality between males and females at the Ancient Greek colony of Himera. We hypothesize that females will have worse oral health than males, as is commonly observed in other contexts. To assess oral health, prevalence of caries in 239 individuals (152 males and 87 females), and abscesses and antemortem tooth loss (AML) in 227 individuals (147 males and 80 females) from Himera were calculated (sex determined following the Global History of Health Protocol). A total of 5384 teeth were examined for evidence of caries and 4305 tooth positions were evaluated for evidence of AML and abscesses. Chi-square and Fisher exact analyses demonstrate that male and female individuals at Himera had an equal chance of developing at least one oral pathology, but females were more severely affected by dental caries and abscesses. Preliminary carbon and nitrogen isotope analysis indicate that males and females at Himera were eating similar types of foods in relatively equal quantities. Therefore, differences in female oral health at Himera are possibly due to biological factors, such as early dental eruption or cariogenic saliva related to female hormones. In the future, we plan to examine other skeletal stress indicators, in addition to indicators of diet, in order to better characterizing potential gender-based inequality in Ancient Greece.

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Testing body mass estimation methods: the Mississippi State Asylum Cemetery

SHAMSI DANESHVARI BERRY

Informatics and Information Management, University of Mississippi Medical Center

Body mass has long been studied by anthropologists to determine the lifestyle and health of individuals and populations. There are several methods that can be used to estimate body mass: bi-iliac breadth, femoral head diameter, subtrochanteric dimensions and a multi-element model. The multi-element model was created to minimize the drawbacks of current methods. In the case of poor preservation, the multi-element method includes predictive models for 29 measurements. This study seeks to determine which method(s) will work in a "real world" sample. Sixty-six unidentified burials have been excavated from the Mississippi State Asylum in Jackson, MS (AD 1855-1935). The preservation of the remains is not pristine but it gives us insight into life in asylums in the 19th and early 20th centuries.

Twenty-nine measurements (including bi-iliac, subtrochanteric and femoral head) were attempted. No measurements could be taken on 40 skeletons (60%) due to their fragmentary nature. The full multi-element model (which includes: midshaft, articular and bone length measurements) could not be used; however, the method also includes prediction models for each of the 29 measurements. As a result, estimations were calculated on 26 individuals (39%). Bi-iliac breadth could not be determined on any of the 66 remains. Femoral head measurements were taken on 7 skeletons (10%). Subtrochanteric measurements were taken on 21 individuals (31%). In conclusion, the best methods include subtrochanteric dimensions and the single element predictive equations of the multi-element model.

The poetics of violence in post-medieval England: using historical documents, clinical and epidemiological data, and bioarchaeological evidence to work towards the identification of gendered performative violence in the past

MICHELLE L. DAVENPORT[1], MOLLY K. ZUCKERMAN[2], PETRA BANKS[2] and RYAN J. KING[2]

[1]Cultural Resource Management, Commonwealth Heritage Group, Inc., [2]Anthropology and Middle Eastern Cultures, Mississippi State University

Whitehead's model "the poetics of violence" analyzes violence within the context of a culture's history and norms to understand the meaning behind violent acts and what each act contributes to the formation—or confirmation—of the social identity of individuals and communities. Here, we employ Whitehead's model to identify and interpret modes of performative violence within post-Medieval England. We follow Stone's approach for identifying bioarchaeological evidence of performative modes of bodily control that are historically documented but regarded as archaeologically invisible. We focus on skimmingtons (i.e. rough music or *charivari*), violent instances of public shaming conducted in response to excess domestic violence and lost sexual honor, which regulated gendered social identities. Using social theory, historical sources, and established skeletal indicators of domestic violence (i.e. anterior cranial blunt force trauma; craniofacial and anterior rib fractures) applied to five post-medieval London skeletal assemblages (N=413), we assess potential evidence of domestic violence and skimmingtons. Of the 27.3% of individuals in the sample with trauma, 15% manifest lesions associated with interpersonal violence; of these, 41% present cranial blunt force trauma (14% female, 86% male) and 29.4% rib fractures (40% female, 60% male), potentially indicative of domestic violence. Further, we propose bioarchaeological criteria for identifying victims of skimmingtons, rough music, or *charivari* in post-Medieval Europe, including social and biological profiles of typical subjects and the trauma potentially generated by skimmingtons.

The Origins and Evolution of Urban Amazonia: A Molecular Anthropology Perspective

RANDY E. DAVID

Anthropology, University of Kansas

Located parallel to the Andes-Amazon transition zone, Yurimaguas and the Huallaga Valley of Peru has attracted peoples for millennia (beginning in the early Holocene, followed by Spanish Conquistadors [16th century], Rubber Boom [late 19th century], and Oil Boom [late 20th century]) as a means of trans-Andean human, information, and goods transportation. Recent investments in transportation infrastructure including the trans-Andean Highway, linking Yurimaguas with coastal and Andean Peru for the first time, as well as the construction of an international river port, significantly increased the percentage of urban residents in the district and nearly doubled the population between 1981 and 2007, from 36,417 to 63,345.

Approximately 180 DNA buccal swabs were collected from two locations within the district of Yurimaguas, in addition to migration-based life histories. Mitochondrial DNA was Sanger sequenced, and Y-chromosomal DNA typed using a commercially available Y-STR kit. Analysis

was conducted with the goal of addressing how both historic and recent migration processes have shaped the modern, urban Amazonian environment in regards to autochthonous American versus foreign haplogroup representation, gender-skewed gene flow, overall genetic diversity, and diversity measures according to place of birth, language, residence, and age. Findings suggest that most residents possess indigenous American ancestry, and that this trend is particularly evident in mitochondrial DNA. Haplogroup analysis suggests a "patchwork" of recently-isolated lowland Amazonian populations intermingled with individuals of foreign, mostly European ancestry. Diversity measures moreover appear to be significantly associated with numerous demographic and migration-based features.

Image Registration and Template Based Annotation of Great Ape Skulls

CHRIS DAVIS[1] and A. MURAT MAGA[2,3]

[1]Anthropology, The University of Texas at Austin, [2]Pediatrics, University of Washington, [3]Anthropology, University of Washington

The growing use of high resolution three-dimensional imaging, such as micro-computed tomography, along with advances in visualization and analytic software have provided researchers with the opportunity to study the morphology of organisms in more detail and quantitatively. In this context, geometric morphometric methods are a suite of analytic techniques aimed at studying shape variation through annotation of landmarks corresponding to anatomical structures of interest. Yet, manual annotation of 3D datasets remains a labor-intensive process, which can introduce observer bias that can impede the detection of differences.

We have previously shown that image registration algorithms can help automate the annotation of the cranial and mandibular landmarks on mouse heads that were digitized via microCT. Here, we demonstrate that same approach can be used to automatically record landmarks on great ape skulls. Using available scans from the Smithsonian Institution's great ape collection, we have manually digitized a standard set of facial and cranial landmarks from a total of 90 crania from three extant ape species (*Gorilla gorilla*, *Pan troglodytes*, and *Pongo pygmaeus*). We used the biomedical image registration library Advanced Normalization Tools and its associated R image analysis library to generate: (1) species-specific synthetic image templates, and (2) a multi-species synthetic image template. Our analyses showed that multi-species template lack the anatomical clarity to obtain precise landmarks, but it is possible to annotate landmarks from species-specific synthetic templates. Future availability and use of such templates can alleviate concerns regarding different types of observer biases and open up possibilities for large-scale morphometric analyses.

Non-metric traits at the enamel-dentine junction of hominoid mandibular third premolars

THOMAS W. DAVIES[1,2], LUCAS K. DELEZENE[3,4], JEAN-JACQUES HUBLIN[1] and MATTHEW M. SKINNER[1,2,4]

[1]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [2]School of Anthropology and Conservation, University of Kent, [3]Department of Anthropology, University of Arkansas, [4]Evolutionary Studies Institute, University of Witwatersrand

Studies of hominoid dentition often focus on molars since they show the highest levels of crown complexity. However, a number of dental traits have been identified in premolars which are interesting in terms of taxonomy, function and development. These traits, however, can be difficult to identify in worn teeth. One solution is to look at the enamel-dentine junction (EDJ), which is often preserved in teeth with moderate wear, and has a high level of concordance with the outer enamel surface (OES).

Here we employ microcomputed tomography to image the EDJ of a large sample of mandibular third premolars (P_3) in non-hominin apes, fossil hominins, and modern humans (n=105) to investigate the presence and expression of a number of P_3 traits including buccal grooves, the transverse crest, and mesial and distal marginal ridges.

We find that a continuous transverse crest is extremely common in hominin P_3s (>80%), but in non-hominin apes, is only found in *Pongo*. Accessory crests are particularly common in *Homo neanderthalensis*, and it is possible that these are developmentally homologous to accessory crests in fourth premolars, as well as molar trigonid crests. Development of the marginal ridge is associated with premolar molarisation, and fully continuous marginal ridges are seen in all *Paranthropus* specimens studied here. In late *Homo* specimens however, the mesial and distal marginal ridges are often interrupted on the lingual side of the tooth. Many of these traits are less clear at the OES, further underlining the utility of the EDJ for analyses of dental morphology.

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Post-canine dental variation and species diversity in small-bodied dendropithecids from middle Miocene deposits at Maboko, Kenya

ERICA R. DAVIS[1], BRENDA R. BENEFIT[1], MONTE L. MCCROSSIN[1] and RUTGER JANSMA[2]

[1]Anthropology, New Mexico State University, [2]Anthropology, University of Minnesota

Numbers of dendropithecid postcanine teeth from Maboko Island increased from 26 to 186 due to the 1987-1997 excavations, with most deriving from Beds 3 (n=61) and 5 (n=60) dated to between 14.7 and 16 mya. An additional dendropithecid mandible with P3-M3 from Bed 12 radiometrically dates to 14.7-13.8 mya. Morphological comparison and discriminant function analysis reveals a greater diversity of dendropithecid species than expected in the middle Miocene, including at least five taxa and two genera at Maboko.

Most postcanine teeth are morphologically consistent with "*Micropithecus*" *leakeyorum*. However three variants of this species are observed, with specimens from Bed 5 consistent with the type KNM-MB 11660. Lower molars from Bed 3 are statistically significantly larger and M1 mesial shelves are more triangular than those from Bed 5 suggesting at minimum a subspecies distinction. A third tiny variant from Bed 5 represented by a mandible with P3-M3 is distinguished by premolar morphology and is the smallest dendropithecid yet discovered.

Other dendropithecids are rare at Maboko and limited to Bed 3. Six isolated lower teeth and one upper I1 are consistent in morphology and size with both *Simiolus enjiessi* and some specimens of *Dendropithecus macinnesi.* No Maboko upper molars have the squared off corners and crisp cingula characteristic of *Simiolus enjiessi*, although four vaguely resemble *Dendropithecus* and/or *Limnopithecus evansi*.

The Bed 12 mandible represents a third species distinguished by molar cusps set further apart and an M3 that is distally wider with a more *Kogolepithecus*-like arrangement of cusps than "M." leakeyorum.

These fossils were collected and analyzed with the support of the National Science Foundation, L.S.B. Leakey Foundation, Wenner-Gren Foundation, National Geographic Society and a Collaborative Fulbright grant.

Developing the *International Optimal Childbirth Initiative* (IOCI): Applying Anthropology to Lower Cesarean and Other Intervention Rates and Improve Outcomes in Birth Worldwide

ROBBIE E. DAVIS-FLOYD

Anthropology, University of Texas

In 2008, the International MotherBaby Childbirth Organization (IMBCO) launched the *International MotherBaby Childbirth Initiative (IMBCI): 10 Steps to Optimal Maternity Services*, now used as a template for optimal care in many small-scale services and several large hospitals, all of which have shown dramatic intervention rate drops and outcome improvements. But, as a small volunteer NGO, we had no funding for assessment or certification. In 2014, FIGO published its own initiative, "Mother-baby friendly birthing facilities";

both initiatives had Steps that the other did not. In 2017 we merged our initiatives to create the *International Optimal Childbirth Initiative (IOCI): 12 Steps to MotherBaby-Family-Friendly Maternity Services*. The IOCI addresses the failure of the global movement of birth into facilities to lower intervention and maternal and perinatal mortality rates, and seeks to remedy this situation by improving quality of care—shown to be the major reason for these failures. The IOCI is currently under review by other major global organizations (WHO, ICM, WRA, IPA, etc). We have developed indicators and criteria for assessment and certification of a facility or practice as **Motherbaby-Family-Friendly**. The IOCI (which includes the BFHI as its 12th Step) is the most comprehensive effort created to date to minimize intervention rates, including CS, decrease mortality rates, and ensure respectful, woman-centered care. This talk presents the 12 Steps of the IOCI and plans for its implementation, and describes how my global anthropological awareness helped me, as its primary wordsmith, to make sure it could work in both high- and low-resource settings.

Studying A Captive Breeding Bornean Orangutan From Breeding to Post-Partum at The Smithsonian's National Zoo

LISA M. DAY[1], MARIE VERGAMINI[1,2], MEREDITH BASTIAN[3] and AMY L. RECTOR[1]

[1]Anthropology, School of World Studies, Virginia Commonwealth University, [2]Department of Biology, Virginia Commonwealth University, [3]Primate Unit, Smithsonian's National Zoo

The Association of Zoos and Aquariums' Orangutan Species Survival Plan® aims to maintain 100 Bornean orangutans (*Pongo pygmaeus*) of underrepresented mitochondrial lineages in captivity. Because of the high required investment in breeding individuals of these lineages and what often manifests as a "mismatch" of compatible orangutan personalities, it is essential that zoos understand how best to manage sociality of potential mothers. To improve management and reproductive success of these animals, more observational research needs to be conducted from pre-gestation to through the infant's first year of dependency.

The Smithsonian's National Zoo's two adult Bornean orangutans successfully bred and gave birth to a male offspring in September 2016. The breeding female was observed over two years, from pre-pregnancy to offspring's sixth month of age, to explore how her behaviors changed or modified over time. Results indicate that during the pre-pregnancy phase, the breeding female socialized more with two other females over the males, but also socialized more with the male who did not sire her offspring. During the pregnancy period, the pregnant female socialized in less energy-consuming ways, i.e. grooming instead of playing. Post-partum socialization and nearest data suggest a shift in female preference, probably due to the other orangutans' maternal experience. These data, especially those relating to fluctuating relationships between the breeding female and males, may help guide socialization options for future pregnant captive orangutans to improve breeding and birth of offspring success. Another female's presence with maternal experience may also be beneficial to the rearing of the new offspring.

Covariation patterns and respiratory simulation in modern human and Neanderthal noses

SOLEDAD DE AZEVEDO[1], CELIA CINTAS[1], MARINA GONZALEZ[1], VIRGINIA RAMALLO[1], MIRSHA QUINTO-SANCHEZ[1,2], FEDERICO MARQUEZ[3], TABITA HUNEMEIER[4], CAROLINA PASCHETTA[1], ANAHI RUDERMAN[1], PABLO NAVARRO[1], BRUNO PAZOS[1], CAIO SILVA DE CERQUEIRA[5], OSVALDO VELAN[6], FERNANDO RAMIREZ-ROZZI[7], NESTOR CALVO[8], HUGO CASTRO[11,9], RODRIGO PAZ[10,11] and ROLANDO GONZALEZ-JOSE[1]

[1]Instituto Patagónico de Ciencias Sociales y Humanas, Centro Nacional Patagónico – CONICET, [2]Ciencia forense, Facultad de Medicina,, Universidad Nacional Autónoma de México, [3]Instituto de Biología de Organismos Marinos, Centro Nacional Patagónico – CONICET, [4]Departamento de Genética e Biologia Evolutiva, University of São Paulo, [5]Superintendência da Polícia Técnico-Científica do Estado de São Paulo, Equipe de Perícias Criminalísticas de Ourinhos, [6]Departamento Académico de Ciências Morfológicas, Hospital Italiano, [7]UMR 5288 AMIS, CNRS, [8]Department of Computing, Universidad Nacional del Litoral, [9]Instituto de Modelado e Innovación Tecnológica, Universidad Nacional del Nordeste, [10]Livermore Software Technology Corporation, LSTC, [11]Consejo Nacional de Investigaciones Científicas y Técnicas, CONICET

It is likely that a proper respiratory performance on cold and dry climates was an adaptive pre-requisite to the human settlement of Eurasian landscapes during the last Glacial Maximum. Research on covariation patterns among different anatomical parts of the nasal tract is of key importance to simulate the respiratory performance under several conditions. Data on covariation among soft versus hard tissues, or vestibular versus nasopharyngeal structures, for instance, is necessary to obtain a proper *in silico* reconstruction of the internal nasal tract. Here we present an extensive covariation analysis of nasal tracts including human and non-human primates as well as hard and soft tissues obtained via Computed Tomography. Furthermore, we used warping techniques to reconstruct three complete nasal tracts corresponding to two modern human populations evolved on temperate (southern European) and cold-dry (eastern Asian) climates, and a generic Neanderthal nose. Reconstructed noses including the mucosa surface were submitted to Computational Fluid Dynamics (CFD) in order to simulate respiratory regimes and climatic conditions. Simulations revealed that across-individuals differences in fluid residence time significantly affect nasal humidification and warming dynamics. Under cold/dry climatic regimes, the eastern Asian model achieved the most rapid conditioning at the vestibular region, followed with slightly less rapid conditioning by the Neanderthal model. In contrast, the southern European model reached a physiologically satisfactory conditioning less rapidly, around the medium-posterior nasal tract. These CFD results suggest that proper air conditioning is attained in some human groups and Neanderthal nasal tracts despite significant among-taxa craniofacial differences.

Rome wasn't built in a day: biomolecular analysis of ancient Romans

FLAVIO DE ANGELIS[1], CRISTINA MARTÍNEZ-LABARGA[1], ANDERS GÖTHERSTRÖM[2], VALENTINA GAZZANIGA[4], PAOLA CATALANO[3] and OLGA RICKARDS[1]

[1]Department of Biology, University of Rome "Tor Vergata", Rome, Italy, [2]Department of Archaeology and Classical Studies, Stockholm University, Stockholm, Sweden, [3]Anthropology Service, Soprintendenza Speciale Archeologia Belle Arti e Paesaggio di Roma, Rome, Italy, [4]Department of Molecular Medicine, Sapienza University of Rome, Rome, Italy

Recent archaeological excavations carried out in Rome have revealed hundreds of burials mainly dated back to the Imperial Age (1st-3rd centuries CE), when the city of Rome reached its greatest demographic expansion. The huge development of biomolecular techniques allows to recovery ancient molecules from biological remains, thus providing a powerful tool for reconstructing crucial aspects of the history of Rome as well as its ecological and genetic structure, to be properly understood in the frame of the huge historical and literary sources about its lifestyle and society. One of the main topic addressed by molecular assessment is the Romans' dietary habits: isotopic data are consistent with a heterogeneous landscape where each community seems to be featured by private foodstuff preferences. Indeed though the average diet should be based on C3 terrestrial resources consumption, several specific nutritional requirements could be pointed out. Genetic evaluation is an outstanding task to deepen the knowledge about the population stratification: whole genomes are able to dissect the population genetic makeup and strontium/oxygen synergic evaluations shed light on the Rome migration pattern in Imperial Age: the quantitative assessment of migration flows have been compared to demographic projections in order to elucidate the mandatory people movements to ensure City welfare. Selective genetic markers have been evaluated to identify putative genetic disorders people suffered from: their molecular

characterization have aided in the identification of the pathocenosis affecting ancient Romans and several susceptibility loci revealed specific variation in pathological individuals.

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Greater Male Variability in Chimpanzee (*Pan troglodytes*) Brain Structure

ALEX R. DECASIEN[1,2] and WILLIAM D. HOPKINS[3]

[1]Anthropology, New York University, [2]NYCEP, New York Consortium in Evolutionary Primatology, [3]Neuroscience Institute, Georgia State University

Across taxa, sexually selected traits are more variable in the target sex than 1) the same trait in the opposite sex or 2) non-sexually selected traits, likely due to their condition-dependent expression. In humans, males show greater variability in certain cognitive abilities and brain structures that 1) may facilitate intra- or inter-sexual competition and 2) are greater/larger in males on average, suggesting these traits may also have been subject to sexual selection. This study investigates sex differences in brain structure variability in chimpanzees. Although male chimpanzees exhibit strong intrasexual competition, reproductive skew is reduced by female mate choice and male coercion. In vivo MRI scans were collected from 226 (135F/91M) individuals and surface areas were calculated for 25 cortical sulci. Outliers for each sex and sulcus were removed prior to analysis. We measured sex differences in variability by calculating the ratio of male-to-female standard deviations of MCMCglmm residuals, controlling for age, rearing condition, scanner type, and kinship. We tested for significant sex differences through permutation. We find that males are significantly more variable at the cingulate (ratio=1.18;p=0.043), middle-frontal (ratio=1.36;p=0.001), occipital-lateral (ratio=1.20;p=0.029), occipital-temporal-marginal (ratio=1.8;p=0.006), superior-temporal (ratio=1.36;p<0.001), subcentral-posterior (ratio=1.62;p=0.033), and superior-parietal (ratio=1.21;p=0.028) sulci. These regions are associated with social perception, face recognition, and motion prediction. Females are more variable at the medio-parietal-occipital sulcus (ratio=0.78;p=0.009), a region associated with planning. This is the first study to demonstrate greater male variability in brain structure in a nonhuman primate species, and suggests sexual selection may lead to greater variability in male cognition across taxa.

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Understanding human craniofacial bone properties and biomechanics - a perspective on macaques, baboons, and beyond

PAUL C. DECHOW

Biomedical Sciences, Texas A&M University College of Dentistry

Studies of the crania of macaques from Cayo Santiago Island have led to insights especially concerning craniofacial growth, suture biology, functional anatomy, and heritability. An understanding of these areas can be enhanced by knowledge of the material properties of the craniofacial skeleton, which are especially important for building models of the function of craniofacial bone. This investigation compares results from separate studies in our laboratory of the material properties of cortical bone of the macaque cranium and mandible. Comparisons of these results to other studies in primates and other vertebrates, including baboons, chimpanzees, gorillas, capuchins, humans, alligators, bats, and pigs, suggest that while there are similarities among species, the details of regional variation are important for understanding patterns of growth and functional anatomy. Material properties including density, cortical thickness, and elastic properties (elastic and shear moduli, and Poisson's ratio) were measured using standard and ultrasonic techniques in 10 adult macaque skulls. Comparisons between mandibular and cranial measurements showed that mandibular cortical bone is overall thicker, denser, and stiffer than cranial bone in most regions. Directional differences in elastic moduli (anisotropy) were similar in many regions of the mandible and cranium, although the mandible did show a tendency toward more consistent orientations of the direction of maximum stiffness. Overall, these regional differences between the mandible and cranium are also found in humans and baboons and are important to consider when modeling bone function in the skull. Bone structure and presumably adaptation presents functionally significant differences between the cranium and mandible.

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Girl, you'll be a woman soon: Examining associations between pelvic dimensions and body composition in growing girls living in London

SARAH-LOUISE DECRAUSAZ[1], JANE E. WILLIAMS[2], MARY S. FEWTRELL[2], JAY T. STOCK[1] and JONATHAN CK. WELLS[2]

[1]Department of Archaeology, University of Cambridge, [2]Childhood Nutrition Research Centre, University College London Institute of Child Health

The relationship between body composition and pelvic dimensions in women is unclear, principally with regards to preparing the body for reproduction. Previous work has demonstrated that pelvic breadth increases more slowly overall than linear growth and that girls reach their mother's height before they reach their mother's pelvic breadth. Fat mass increases as girls enter puberty; however precocious development as a result of increased adiposity in girls is unconfirmed. This study examines the interaction between pelvic breadth and changing adiposity that could impact pelvic dimensions as girls grow into women.

Body composition data and pelvic dimensions were collected from dual energy x-ray absorptiometry (DXA) scans from 286 girls and women living in London today between the ages of 4 and 22 years. Body composition data collected were four-component model lean mass and fat mass. Measures of adiposity collected were subscapular, suprailiac, tricep and bicep skinfolds and waist circumference. Tanner development stages and age at first menses were also collected. Outcome pelvic dimensions collected from DXA scans were bi-iliac breadth, mediolateral inlet breadth and biacetabular breadth. Variables were converted to age-adjusted z-scores to enable accurate body composition comparison between women and growing girls.

Multiple regression analyses demonstrate that only biacetabular breadth and mediolateral inlet breadth were associated significantly with both fat and lean mass. Tanner development stage and waist circumference associated significantly with mediolateral inlet breadth. These results suggest that bony pelvic dimensions vary in association with body composition and adiposity, potentially as part of preparing the female body for reproduction.

This research was made possible with support from the Parkes Foundation.

Sulcal pattern variation in extant human endocasts

EDWIN J. DE JAGER[1], ALBERT N. VAN SCHOOR[1], JAKOBUS W. HOFFMAN[2], ANNA C. OETTLÉ[1,3], CAROLINE FONTA[4] and AMÉLIE BEAUDET[1,5]

[1]Department of Anatomy, University of Pretoria, [2]South African Nuclear Energy Corporation, Pelindaba, [3]Department of Anatomy and Histology, Sefako Makgatho Health Sciences University, [4]Centre de Recherche Cerveau et Cognition, Université de Toulouse, [5]School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand

Our knowledge of human brain evolution primarily relies on interpretation of paleoneurological evidence. In this context, the endocast (i.e., replica of the internal table of the bony brain case) constitutes a proxy for reconstructing a timeline and mode of cerebral changes in human evolution. The identification of cerebral imprints, with specific focus on cortical sulci, is critical for assessing the topographic extension and structural organization of cortical areas. However, the description of these crucial landmarks in fossil

endocasts is challenging. The recent introduction of high-resolution imaging techniques in (paleo) neurology offers new opportunities for tracking detailed endocranial neural characteristics. This study aims at providing an atlas documenting the variation in the extant human endocranial sulcal pattern for subsequent use as a comparative platform for the study of the fossil record. Overall, more than 90 extant human crania from the Pretoria Bone Collection (University of Pretoria, South Africa) were detailed by X-ray microtomography at a spatial resolution ranging from 94 to 123 µm at MIXRAD, located at the South African Nuclear Corporation, Pelindaba. Based on our preliminary analyses, sulci are nearly consistently identifiable on the frontal (i.e., superior, intermediate and inferior sulci) and temporal (i.e., superior and inferior sulci) lobes. Interestingly, sulci bordering critical functional areas (e.g., Broca's cap) could be labelled as well. The construction of an atlas is a prerequisite for developing protocols involving automatic sulci recognition in endocasts. In this regard, our study introduces a promising perspective for discussing long outstanding questions in paleoneurology.

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Making Silenced Voices Speak: Restoring neglected and ignored identities in anatomical collections

CARLINA M. DE LA COVA

Anthropology, University of South Carolina

The Hamann-Todd, Robert J. Terry, and William Montague Cobb anatomical collections have played important roles in the history and development of bioarchaeology. However, little is known about the individuals that comprise these collections as their voices have been silenced. It is important to know who these persons were as our human identification and standardized methods are based on their skeletons. Most were poor, relied on charity hospitals, or were institutionalized. This presentation will utilize cross-disciplinary approaches that push beyond the biocultural synthesis to restore the ignored identities of individuals in anatomical collections. Key to this is the role structural violence played (and continues to play) in targeting the poor and socially marginalized for dissection and skeletal curation. Life history and embodiment theory are also applied, in addition to structural violence, to argue how the socioeconomic status, ancestry, and the mental health of these individuals resulted in their pathologies, institutionalization, and dissection. Restoring the voices and identities of persons in our historic anatomical collections is ultimately important to the discipline, both from an ethical and social justice perspective.

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Genomic insights into early maritime adaptations in Western Patagonia

CONSTANZA DE LA FUENTE[1], VICTOR MORENO-MAYAR[1], MARTA ALFONSO-DURRUTY[2,3], FLAVIA MORELLO[4], MIGUEL VILAR[5], SPENCER WELLS[6], PAULA F. CAMPOS[1,7] and ESKE WILLERSLEV[1,8,9]

[1]Center for Geogenetics, University of Copenhagen, [2]Departamento de Antropología, Universidad Alberto Hurtado, [3]Department of Sociology, Anthropology and Social Work, Kansas State University, [4]Centro de Estudios del Hombre Austral, Instituto de la Patagonia, Universidad de Magallanes, [5]Science and Exploration, National Geographic Society, [6]Insitome, [7]CIIMAR Interdisciplinary Centre of Marine and Environmental Research, University of Porto, [8]Department of Zoology, University of Cambridge, [9]Wellcome Trust Sanger Institute, Wellcome Genome Campus, Cambridge

Several studies have contributed to our understanding of the initial human occupation and diversification in the Americas. However, fewer have concentrated their efforts in geographically restricted areas such as Patagonia. With this work, we aim to contribute to the genomic characterization of local populations from Western Patagonia through the analysis of two ancient individuals from the region. These individuals are associated to the earliest maritime tradition identified in Patagonia, which according to archaeological evidence, developed locally around 6,000 years ago. Given that the connection between early and late maritime populations as well as the geographical origin of this tradition has not yet been fully understood; the analysis of these two early genomes is very valuable to shed light into its origin and later diversification. Low coverage genomes were generated for two individuals dated at 6,290±50 BP and 4,520±60 BP. These data was compared with modern and ancient individuals from America. Using f3 statistics and a Principal Component Analysis, we found a close proximity between the ancient genomes and populations from America, in particular South America. Historical individuals from Patagonia are the closest to both early maritime individuals, reflecting a long-term genetic continuity. Using a D-statistic analysis we saw that among the historical individuals, neither terrestrial nor maritime groups are genetically closer to the early genomes, reflecting their ancestral position before the differentiation of maritime populations. This evidence suggests a single origin for two of the main maritime populations (Kawéskar and Yámana), strongly supporting a deep genetic history in the region.

This study was sipported by several funding bodies: Lundbeck Foundation, the Danish National Research (Centre for GeoGenetics) and the Genographic Program of the National Geographic Society.

My, what big teeth you have! A structural model for relative snout length in primates

VALERIE BURKE. DELEON[1] and TIMOTHY D. SMITH[2]

[1]Department of Anthropology, University of Florida, [2]School of Physical Therapy, Slippery Rock University

Primates exhibit a range of variation in midfacial length. Strepsirrhines tend to have relatively elongated snouts, and most haplorhines are characterized by facial reduction. In our study of growth in neonate primates, we have developed an ontogenetic structural model of primate cranial diversity. Here, we ask whether the size of developing tooth germs predicts the relative length of the midface in primates at or around the time of birth.

We used virtual reconstructions of the cranium from microCT data for neonate primates (late fetal to 6-days-old) representing tarsiers and multiple genera of anthropoids and strepsirrhines. Shape of the cranium was quantified using Procrustes superimposition of landmark coordinate data (k=40). Dental volumes were estimated as the cube root of summed areas of postcanine dentition from serial histology. Distances representing nasal, dental arcade, and cranial base lengths were calculated. Data were scaled by regressing against cranial base length.

Morphometric analyses indicated that the greatest amount of shape variation, including relative length of the midface, was explained by clade. Dental arcade length was significantly greater in strepsirrhines than anthropoids. For the pooled sample of primates, relative dental volume explains almost all the variation in dental arcade length independent of phylogenetic group (r = 0.94, p < .0001), and these values scale isometrically. There was no corresponding relationship of dental volume to relative nasal length. These data suggest that some but not all midfacial differences across major groups of primates are significantly influenced by difference in size and timing of tooth development.

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Population differences in aging-related inflammation are associated with change of central adiposity

ALICIA M. DELOUIZE[1], TYLER M. BARRETT[2], GEETA EICK[1], ELIZABETH THIELE[3], WU FAN[4], YANFEI GUO[4], YE LU[4], AARON SALINAS RODRIGUEZ[5], BETTY S. MANRIQUE-ESPINOZA[5], RICARDO ROBLEDO[6],

SALVADOR VILLALPANDO[6], PAUL KOWAL[1,7,8], NIRMALA NAIDOO[7], SOMNATH CHATTERJI[7] and J. JOSH. SNODGRASS[1]

[1]Anthropology Department, University of Oregon, [2]Department of Anthropology, Northwestern University, [3]Department of Biology, Vassar College, [4]N/A, Shanghai Center for Disease Control and Prevention (China), [5]Centre for Evaluation Research and Surveys, National Institute of Public Health (Mexico), [6]N/A, National Institute of Public Health Laboratory (Mexico), [7]N/A, World Health Organization (Switzerland), [8]Research Centre for Generational Health and Ageing, University of Newcastle (Australia)

A positive association between aging and inflammation has been established in the literature, and is thought to be ubiquitous. However, few cross-population studies have been done, to assess whether this association could be due to localized differences in physical activity, dietary quality, dietary consumption, or health status. We hypothesize that: 1) waist circumference will mediate the effect between age and inflammation (measured by C-reactive protein, CRP); and 2) China (N = 8,629) and Mexico (N = 2,284) will have different associations between aging and waist circumference, which will lead to different associations between aging and inflammation. Structural equation modeling indicated that waist circumference mediated the association between age and inflammation in China (indirect effect β = 0.01, p = 0.01), but not in Mexico (indirect effect β = 0.00, p = 0.74). Further, in Mexico, age was not significantly related to waist circumference (β = 0.01, p = 0.69) or CRP (β = -0.01, p = 0.80). In China, age was positively associated with both waist circumference (β =0.07, p < 0.001) and CRP (β =0.09, p < 0.001). The findings add nuance to the known associations between aging and inflammation, and suggest that population differences and differences in age-related central adiposity, may be responsible for variation in inflammation. Further research may be able to target behaviors leading to differences in age-related central adiposity in an attempt to reduce age-related inflammation and associated disease.

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Does Pelvic Size Follow a Secular Trend?

HILLARY DELPRETE

Department of History and Anthropology, Monmouth University

A secular trend in body size has been thoroughly investigated and is well documented since the 1800's. Additional research shows that pelvic size is linked with body size; however, it is not well known if this same secular trend can be noted in pelvic size. In order to test this, pelvic data from the Hamann-Todd, Terry, and Coimbra Collections was collected and analyzed. Twenty measures were collected from 601 individuals; these measurements included measures of the pelvic canal and measurements outside of the pelvic canal. These 20 measures were averaged for each individual in order to compute an individualized geometric mean variable (GM) that was used as a proxy for pelvic size. To test the relationship between pelvic size and birth year, correlation coefficients were computed between GM and birth year after the data was separated by collection, ancestry, and sex. Further, to determine if the GM value significantly changed through time, MANOVA tests were employed after the data was further sub-divided into three time cohorts: 1833-1860, 1861-1889, and 1890-1918. According to the results of the correlations, birth year was not significantly correlated with pelvic size for any of the samples. Further, according to the MANOVA results, only the mean GM value for the Coimbra males significantly increased from time cohort 2 to time cohort 3; none of the other results were significant. Based on the results of this study, a positive secular trend can only be noted in the pelves of males from the Coimbra Collection.

Navigation through misinformation: Visualizing the realities and fallacies of reproductive choice in the Midwest

VICTORIA DEMARTELLY[1] and NEETU HARIHARAN[2]

[1]Women, Children & Family Health Science, UIC, [2]Global Health, Rollins School of Public Health

Elective abortion, often framed as an amoral decision, has come under hostile legislative attack, resulting in the shaming or even criminalizing of those who choose to seek this service. Illinois has continued to serve as a linchpin of reproductive access in the Midwest. It is the only state in the region not to require a counseling session prior to receiving an abortion, and therefore, no waiting period between counseling and abortion, unlike surrounding states. However, roadblocks still exist in accessing abortion in Illinois, including the limited number of clinics outside of urban centers, and the proliferation of crisis pregnancy centers (CPCs), which use predatory practices to spread misinformation to dissuade pregnant people from obtaining abortions.

We mapped populations of reproductive-aged women, abortion clinics, and CPCs by county in the state of Illinois to paint a clearer picture of the relationship between reproductive choice and access. We used data from 2010 U.S. Census Bureau to map densities of women of reproductive age (15-49) per county in each of the 102 counties in Illinois. We then looked at locations of abortion clinics by county and crisis pregnancy centers using Google results and those listed at http://www.lifecall.org/cpc/illinois.html and http://icl-life.com/Pregasst.htm, by county. Using QGIS, we made choropleth maps and point to visualize information.

Our mapping highlights counties in Illinois that have a dense population of reproductive-aged women but no abortion clinics, as well as the extensive number of CPCs throughout Illinois, showing that where need is high access, and thus choice are impaired.

Assessing dermatoglyphic distances in North American populations and their parental populations: A comparison to craniometrics

JUSTIN J. DEMERE, KRYSTLE N. LEWIS and M. KATE SPRADLEY

Anthropology, Texas State University

Dermatoglyphics, or fingerprints, have been used to look at population structures via biological distances. However, few of these studies have utilized American populations as a sample. The purpose of this study was to assess relatedness of American White, American Black, and Native Americans using data derived from dermatoglyphics and craniometrics. It was hypothesized these groups would be more similar to their parental groups than to each other.

Data was obtained from the Heinz Brehme Dermatoglyphic Dataset and from Howells' Craniometric Dataset. For both datasets, a representative sample was chosen. European groups were chosen as the parental population for American Whites. West African groups were selected as the parental population for American Blacks. Finally, East Asian groups were chosen as the parental population for Native Americans. Left and right radial ridge counts from the dermatoglyphic data were analyzed using canonical discriminant function in SAS. This process was performed first by region (East Asia, West Africa, Europe, and American populations) and then by specific ethnic group for all regions. Craniometric data from Howells' measurements were analyzed using DISPOP. A principal coordinates plot with both data types was generated to assess the pattern of relationship between parental groups and American groups.

Results of this study indicate that dermatoglyphics of the American populations under study are more similar to their respective parental populations than they are to each other. These results are consistent with craniometrics, suggesting that dermatoglyphics can be used in tandem with other anthropometric means to investigate population structures and population histories.

Purification of dental calculus organic and carbonate biofractions improves correlations with bone stable isotope ratios

SOPHIA C. DENT[1], DALE L. HUTCHINSON[1], KRISTIN M. HEDMAN[2], MATTHEW A. FORT[2] and STANLEY H. AMBROSE[3]

[1]Anthropology, University of North Carolina at Chapel Hill, [2]Program on Ancient Technologies

and Archaeological Materials, Illinois State Archaeological Survey, [3]Anthropology, University of Illinois Urbana-Champaign

Purification of organic and carbonate biofractions of calcified tissues is an essential prerequisite for reconstructing diet because the biofractions have different carbon isotope ratios (Ambrose and Norr, 1993). This study is the first to purify the biofractions of dental calculus. As untreated bulk calculus is comprised of varying proportions of organics and carbonate, purification of the biofractions allows more direct comparison of dental calculus to bone isotopic values.

Calculus organic matter and carbonate were purified using well-established methods for skeletal collagen and apatite, modified for the unique characteristics and smaller starting weights of calculus samples. Paired bone and calculus samples were analyzed for 51 individuals of groups with different diets from archaeological sites in North Carolina, Illinois, and Bolivia. The average differences between bone and calculus values are relatively consistent across individuals and sites, including: $\delta^{13}C_{collagen}$ and $\delta^{13}C_{calculus\ organic}$ (4.70 ± 2.53‰), $\delta^{15}N_{collagen}$ and $\delta^{15}N_{calculus}$ (-1.7 ± 1.10‰), and $\delta^{13}C_{bone\ apatite}$ and $\delta^{13}C_{calculus\ carbonate}$ (-2.71 ± 1.85‰). Calculus organic and carbonate $\delta^{13}C$ are well correlated (R^2 = 0.80). The atomic C:N ratio of calculus organics is 5.85 ± 0.86, suggesting C:N as a quality control indicator of calculus analysis, similar to its utility for assessing collagen preservation (Ambrose, 1993). This study highlights the potential of dental calculus as a source of isotopic information from a secondary – and thus more ethically compliant – biomaterial. However, more research is needed to understand the diverse sources of calculus organic matter, and isotopic fractionation and routing processes that control dental calculus isotope ratios.

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New craniodental remains of the type specimen of *Australopithecus sediba*

DARRYL J. DE RUITER[1,2], JULIET K. BROPHY[2,3], RENIER VAN DER MERWE[2], JACQUELINE S. SMILG[2,4,5], STEVEN E. CHURCHILL[2,6] and LEE R. BERGER[2]

[1]Department of Anthropology, Texas A&M University, [2]Evolutionary Studies Institute, University of the Witwatersrand, [3]Department of Geography and Anthropology, Louisiana State University, [4]School of Radiation Sciences, University of the Witwatersrand, [5]Department of Radiology, Charlotte Maxeke Hospital, [6]Department of Evolutionary Anthropology, Duke University

When it was announced in 2010, the holotype specimen of *Australopithecus sediba*, Malapa Hominin 1 (MH1), was comprised of a relatively complete partial skeleton that included a well preserved partial cranium and two mandible fragments. Ongoing excavations at Malapa have resulted in the recovery of a left mandibular fragment and two associated premolars that can be refit to the previously recovered mandibular fragments of MH1. In addition, the new mandibular fragment can be conjoined with another mandibular fragment that is partially exposed in a block of matrix that is presently undergoing preparation; this block of matrix contains additional postcranial elements that are now attributable to the type specimen of *Au. sediba*. Digital reconstruction of the composite mandible indicates that the symphysis is largely preserved, revealing narrowly spaced tooth rows that conform closely to the tooth rows of the maxilla. The premolars provide our first glimpse of unworn specimens in *Au. sediba*, supporting the unique shape of these teeth and the uniquely elongated premolar tooth row in *Au. sediba*. The new mandibular specimen also confirms that, while the mandible of *Au. sediba* shares similarities with other australopiths, it nonetheless differs from other hominin taxa in both size and shape; and, where it differs, it appears most similar to specimens attributed to early *Homo*.

Texas A&M University College of Liberal Arts Cornerstone Faculty Fellowship

Associated *Australopithecus afarensis* second and third metatarsals (A.L. 333-133) from Hadar, Ethiopia

JEREMY M. DESILVA[1], ELLISON J. MCNUTT[1,2], BERNHARD ZIPFEL[3] and WILLIAM H. KIMBEL[4]

[1]Department of Anthropology, Dartmouth College, [2]Ecology, Evolution, Ecosystems, and Society, Dartmouth College, [3]Evolutionary Studies Institute, University of the Witwatersrand, [4]Institute of Human Origins and School of Human Evolution and Social Change, Arizona State University

The 3.2 myr-old A.L. 333 locality of the Hadar site, Afar region, Ethiopia, has yielded nearly 260 individual fossils representing 17 adult and subadult individuals of the species *Australopithecus afarensis.* Included in the sample are nearly 50 pedal fossils. Every element of the *A. afarensis* foot is known except the intermediate cuneiform, cuboid, and some distal phalanges. While the second metatarsal is represented distally by both A.L. 333-72 and A.L. 333-115b, the base of the second metatarsal has remained unknown for this taxon. Here, we present A.L. 333-133, conjoined proximal second and third metatarsals of a single individual, and compare this new fossil to the Mt2 and Mt3 in fossil hominins (n=7), humans (n=47), and extant apes (n=78). As in the modern human, the A.L. 333-133 Mt2 and Mt3 are dorsoplantarly tall relative to the mediolateral width—anatomies hypothesized to provide rigidity to the midfoot. There is a discernable roughened area on the medial base of the A.L. 333-133 Mt2, likely for contact with the lateral aspect of base of the Mt 1 and therefore consistent with an adducted hallux. Together with other material from the Hadar 333 locality, A.L. 333-133 helps reveal a mostly human-like foot in *A. afarensis*, with an adducted hallux and dorsoplantarly tall metatarsal bases adapted to resist tarsometatarsal dorsiflexion and convert the foot into a lever during the push-off phase of bipedal locomotion.

A Preliminary Study of Mandibular M1 Through M3 Cusp Apex Placement: Implications for Dental Reduction

BRENDA L. DETTY and CHRISTOPHER W. SCHMIDT

Anthropology, University of Indianapolis

Dental reduction is often addressed diachronically as changes in mesiodistal (MD) and buccolingual (BL) diameters. We address reduction as it presents in first (M1) through third (M3) molars in order to understand cusp placement as teeth get smaller. The objective was to document M1-M3 cusp metric characteristics including inter-apex distance and cusp height. The study included unworn mandibular molars from Late Archaic period Native Americans. We used 17 first, 11 second, and 8 third molars. Sexes were pooled in this pilot effort. Teeth were replicated using a Modela 3D plotter at a 0.15 mm x-y interval. Cusp apices were located using a mouse-driven pointer on wire-frames; intercusp measurements were calculated using Dr. Picza® software. Intercusp dimensions included: protoconid-metaconid, protoconid-hypoconid, metaconid-entoconid, and hypoconid-entoconid. Cusp heights were calculated by subtracting the lowest central pit value from the z-value for each apex. The current study emphasized differences between M1s and M3s. The greater reductions in diameter were in the MD plane; the metaconid-entoconid reduced on average 1.36 mm while the protoconid-hypoconid diameter reduced 0.34 mm. The BL diameters did not reduce. The greatest cusp height reductions were for the metaconid and the entoconid, each of which reduced around 0.87 mm. By contrast, the protoconid and hypoconid reduced only 0.08 and 0.22 mm, respectively. Overall, there were more reductions on the lingual aspect of the third molars, both in terms of intercusp dimensions and cusp height. This study indicates cusp placement asymmetry that merits further investigation.

Absence of Y-chromosome gene flow despite high mating success of hybrid males in the *Cercopithecus* hybrid zone at Gombe National Park, Tanzania

KATE M. DETWILER[1] and CHARLENE KORCHIA[2]

[1]Anthropology, Florida Atlantic University, [2]Psychology, Florida Atlantic University

Gombe National Park, Tanzania, is the only known site where ongoing hybridization occurs between sympatric *Cercopithecus* species. Hybrids are common (~15% of the population) and females are fertile, however the fitness of hybrid males is unknown. If hybrid males are fertile and experience mating success, Y-chromosomal gene flow should be detected in the population. The goals of this study were to (1) increase previous sample sizes of *C. ascanius* and *C. mitis* males from the hybrid zone to test for Y-DNA introgression, and (2) investigate reproductive behavior of hybrid males to understand their mating success. For genetic analyses, we used fecal samples collected from males with known phenotype throughout the hybrid zone. We collected mating data *ad libitum* from habituated hybrid groups intermittently from 2005-2015. The genetic results indicated that *C. mitis* and *C. ascanius* males fathered hybrid sons (n = 10 hybrid males), yet we detected no evidence of Y-chromosomal gene flow (n = 32 *C. mitis* and *C. ascanius* males). We found that hybrid males mated with females of all phenotypes (n = 22 matings), but mated significantly more than expected with hybrid females (chi-square = 10.8, 2 df, p = .004). The Y-DNA results support Haldane's rule—the heterogametic sex is the first to be affected by fitness costs of hybridization. However, the mating results indicate that paternity testing will be required to understand the variation in hybrid male fitness. There will be significant implications to hybrid speciation if hybrid males experience reproductive success with hybrid females.

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DiceCT visualization of lemuroid mimetic musculature with a focus on *Daubentonia*

ASHLEY R. DEUTSCH[1], ANNE M. BURROWS[2,3] and ADAM HARTSTONE-ROSE[4]

[1]Department of Cell Biology and Anatomy, University of South Carolina School of Medicine, [2]Department of Physical Therapy, Duquesne University, [3]Department of Anthropology, University of Pittsburgh, [4]Department of Biological Sciences, North Carolina State University

Mimetic musculature in primates is associated with visual communication. While the gross anatomy of these muscles has been studied for many primates, this musculature is exceptionally thin and integrated with connective tissue, precluding the evaluation of functional variables such as physiological cross-sectional area (related to force production) and fiber length (related to speed and stretch) through traditional approaches of chemical dissection.

To solve this, we are now visualizing mimetic musculature in a sample within Lemuroidea through the use of DiceCT. This technique allows visualization of individual muscle fascicles in situ. Our sample includes *Daubentonia madagascariensis*, the most basal branched living lemuroid, as well as several other lemuroids, allowing for a comparative evolutionary sample that can illuminate patterns of the morphological adaptation across the superfamily and contextualization of the mimetic muscles of this most peculiar primate.

Despite great diversity in facial musculature among haplorhines and the many other apomorphies in *Daubentonia*, mimetic musculature across our lemuroids did not differ significantly. The lack of variation is indicative of a primitive configuration of mimetic musculature for all lemurs, which particularly allows for nasolabial and ear mobility. Although these adaptations have been tied to visual social communication the fact that the relatively solitary and nocturnal *Daubentonia* shares the lemuroid mimetic muscle configuration could indicate that mimetic musculature in lemuroids may have been shaped by demands not associated with visual communication via facial expression. We believe that DiceCT will allow greater understanding of the functional abilities of mimetic muscles unavailable based on previous methods.

Inhibition of sympathetic tone prevents cold-induced bone loss in a mouse model of cold-dwelling humans

MAUREEN J. DEVLIN, CHRIS TOM, AMY E. ROBBINS, MIRANDA N. COSMAN, TAYLOR SPENCER, CLEO MOURSI and RACHEL HURWITZ

Anthropology, University of Michigan

Chronic cold exposure is associated with bone loss in cold-dwelling humans and in animal models, but the mechanisms involved remain unclear. Cold stress upregulates the sympathetic nervous system, which is known to cause bone loss via osteoblast beta-adrenergic receptors. Therefore, we hypothesize that sympathetic activation is a significant cause of cold-induced bone loss, and that such bone loss may be reduced by warming the body through nonshivering thermogenesis (NST) via uncoupling protein-1 (UCP1) in brown adipose tissue.

To test these hypotheses, we used our mouse model of chronic cold exposure to compare skeletal phenotype in untreated mice vs. mice treated with a blocker of beta-adrenergic signaling. Wildtype C57Bl/6J male mice were pair housed at 26°C (thermoneutrality) and 16°C (moderate cold stress) from 3-12 wks of age with food ad libitum. Half of the mice at each temperature were given the beta-adrenergic blocker propranolol in drinking water ad libitum (0.5 mg/mL) (N=8/group). Results indicate that cold exposure decreased bone mineral density, trabecular bone microarchitecture, and cortical bone mass at 16°C vs. 26°C, despite increased core body temperature and higher UCP1 expression. In mice at 16°C, propranolol completely prevented bone loss in both trabecular and cortical compartments, even though UCP1 expression was significantly reduced and body temperature was unchanged. At 26°C, propranolol had no effect on bone mass, body temperature, or UCP1. These data demonstrate that blocking sympathetic tone prevents cold-induced bone loss in mice, implicating sympathetic activation as a significant contributor to cold-induced bone loss in humans.

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Investigating the underlying causes of "circumferential deviation of the olecranon process"

JENNIFER K. DEWEY

Anthropology, Florida Atlantic University

The purpose of this research is to define and understand the underlying causes of a notable deviation of the bony architecture of the proximal ulna, as exhibited by the prehistoric population of Republic Groves(RG). The literature contains few articles describing this morphological variation; therefore, this has been tentatively described here as a "circumferential deviation of the olecranon process." The RG (8HR4) population dates to the middle archaic (4600 - 500 B.C.) in west-central Florida. This poster illustrates the frequency of variation present in the ulna of the RG collection (n= 22) and compares it a modern teaching collection(MTC) (n=18). The samples are coded as absent or present, and further delineated as showing slight, moderate, or significant changes. Results indicate that the feature is present 88.9% MTC in comparison to 90.9% in the RG collection. The MTC sample ranges from slight to moderate; however, the degree of expression in the RG sample is more pronounced, with two examples showing significant changes. The position of the feature suggests that the posterior joint capsule inserts directly on the area. The medical literature suggests that a contributing factor could be from medial shearing caused by valgus stress acting directly on the olecranon shape. Conversely, the olecranon themselves are mostly nonreactive, lacking bone formation, or evidence of erosion. A possible reason for the nonreactive surface could stem from the timing of the initial stress. If found viable this feature could be used to assess overuse injuries when examining activity patterns in a biocultural context.

Plagues past and present: the modern relevance of archaeological studies of epidemics in the past

SHARON N. DEWITTE

Anthropology, University of South Carolina

The Black Death was an emerging infectious disease of the 14th century and one of the most devastating epidemics in history. This

paper summarizes previous bioarchaeological research on conditions preceding the Black Death (*c.* 1349), mortality patterns during the epidemic, and changes in health and demography in its aftermath in London. This paper also presents new findings from burials associated with the *pestis secunda* in London (*c.* 1361), a topic that has received little attention from scholars. Analyses reveal that the age-at-death distributions from plague burials in 1349 and in 1361 do not differ significantly from each other ($p > 0.05$), but each is different from a normal medieval mortality (non-plague) distribution ($p < 0.05$ in both cases). Notably, there is a higher proportion of children (under age 10) in the 1361 plague burials compared to both the earlier plague burials and the non-plague burials, which is consistent with the descriptor "mortality of children" for the second outbreak of plague in historical documents. This could reflect age-related patterns of vulnerability following the Black Death, and suggests there might have been very rapid changes in medieval plague epidemiology following its initial emergence. Bioarchaeological research on medieval plague provides an example of how research on past disease can reveal the conditions that make populations vulnerable to new diseases, patterns of variation in risk associated with previous physiological stress and age, and the effects that epidemics can have on population-wide health patterns, all of which might have parallels in living populations.

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Kinship, Social Relationships, and the Gut Microbiome

LAURA O. DIAKIW[1], STACEY TECOT[1], AURA RAULO[2], AVERY LANE[3], ALICIA S. ARROYO[4], SOAFINIRY RAZANAJATOVO[5], AMANDA MANCINI[6], APARNA CHANDRASHEKAR[7], AMANDA PUITIZA[7], SANTIAGO CASSALETT[6], RAQUEL LAMELA-LOPEZ[6], KATHERINE R. AMATO[8] and ANDREA L. BADEN[6,7]

[1]Department of Anthropology, University of Arizona, [2]Zoology Department, Oxford University, [3]Department of Anthropology, Washington State University, [4]Institut de Biologia Evolutiva, University of Barcelona, [5]Département de Biologie Animale, Université d'Antananarivo, [6]Department of Anthropology, CUNY Graduate Center & NYCEP, [7]Department of Anthropology, Hunter College, [8]Department of Anthropology, Northwestern University

The gut microbiome consists of the population of microbes that live in an individual's gastrointestinal tract. In primate species, individuals who disperse from their natal group may shape their adult stable microbiome through physical contact, shared environments, and shared diet with their new group members. However, it is possible that individuals retain the dominant microbiome composition that they developed as an infant in their natal group even after joining their new group. The combination of social group influence and maternal vertical transmission may provide insight into the similarity between group members' gut microbiome composition.

To determine if the natal group microbiome is retained after dispersal in adult individuals, we tested whether related *Eulemur rubriventer* (red-bellied lemurs) individuals living in different social groups overlap in microbe composition, and if areas of overlap are distinct compared with unrelated members of their current social group, and related individuals in the current social group. Using census and genetic data, we determined the social group membership and relatedness of 15 individuals. Quantitative real-time PCR and Microbial 16S ribosomal RNA gene sequencing indicated that diversity, richness, and composition of *E. rubriventer* microbiomes varied mostly with host social group, with social group accounting for 25% of the variation in composition of *E. rubriventer* microbiomesand kinship accounting for just 2.4% of variability in gut microbiome diversity. The gut microbiome was not shown to be a function of host genetic kinship, prompting reconsideration of the importance of the initial vertical transmission of microbes from mother to infant.

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Human interaction and mobility among Copper Age mega-sites enclosures in Iberia through strontium isotope analyses

MARTA DÍAZ-ZORITA BONILLA[1] and ANNA WATERMAN[2]

[1]Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters, Tübingen Universität, [2]Natural & Applied Sciences, Mount Mercy University

This paper uses recently acquired strontium isotope (^{87}Sr / ^{86}Sr) data from the Copper Age sites of Valencina, La Pijotilla and Zambujal in southern Iberia in combination with AMS radiocarbon dates and new bioarchaeological information to reconstruct human mobility patterns among these communities. The Copper Age in this region is characterized by increasing social complexity, population aggregations and long distance exchange of exotic goods. While these social transformations suggest increased human mobility, little is known about the actual movement of individuals across the landscape. Results showed that the amount of individuals with a non-local signature at those Copper Age mega-sites (Díaz-Zorita Bonilla, 2017; Waterman, 2015) are significantly higher than to other smaller megalithic sites. Therefore, mega-sites are special places for exchange where population aggregation and human interactions can be detected based on strontium isotope analysis. The results of this study point to clear evidence of human mobility and provide a new interpretation of the social and economic dynamics of these 3rd millennium BC communities.

Forensic Science, Death, and the Public: Towards Effective and Compassionate Communication

ELIZABETH A. DIGANGI[1], ARIEL GRUENTHAL-RANKIN[1] and MICHAEL "SONNY" TRIMBLE[2]

[1]Anthropology, Binghamton University, [2]Mandatory Center of Expertise for Archaeological Curation and Collections Management, US Army Corps of Engineers

Over the past four decades, anthropologists have increasingly been involved in death investigations, often including those that are particularly tragic due to mass disasters or human rights violations. Pioneers such as the late Clyde Snow set the example for involving family members as part of the investigation process. Since this precedent, familial engagement has become best practice, emphasizing a holistic approach to death investigation. From 1879 to 1918, Carlisle Indian Industrial School was the first location of many off-reservation Indian residential schools in the United States. Over 10,000 children from multiple tribes attended these schools. The historical record indicates 180 tribal members died during their tenure at Carlisle. The United States Army decided to enter government-to-government relations to exhume members of the Northern Arapaho tribe who died and were buried at Carlisle. We will discuss engagement with the families during exhumation, analysis, and return proceedings carried out under the auspices of the Army National Military Cemeteries, US Army Garrison, Carlisle Barracks. The entire team was cognizant of the importance of the model being set, given the novelty of the proceedings and stakes involved. As a result, we followed best practices first set by Dr. Snow that continue: team leader continuous communication with a family liaison coupled with individual family interaction with the forensic anthropologists. Key to our mutual success was trust-building that began well before exhumation and analysis. Here we discuss our employed strategies and overall approach towards resolution and some semblance of closure for the families and descendants.

What's for dinner? Diurnal variation in wild Bornean orangutan food and nutrient choices

ANDREA L. DIGIORGIO, ANDREA B. BLACKBURN and CHERYL D. KNOTT

Biological Anthropology, Boston University

Previous observational research on primate feeding ecology has demonstrated that some

primates consume fruit in the morning and leaves in the afternoon. However, diurnal patterning of feeding bouts has not been demonstrated for many of the apes, nor for relatively solitary primates. Furthermore, whether this has nutritional consequences is unclear. Orangutans are largely frugivorous omnivores that also incorporate leaves, bark, pith, and insects in their diet. As primarily solitary animals, their foraging and food choices are not restricted by group size and group decisions – thus they provide an excellent species with which to examine individual ape foraging choices. In accord with previous research, we hypothesized that orangutans would select energy rich and easy to digest foods (i.e., fruit) in the morning, then move to leaves and more fibrous food sources later in the day in order to allow more digestion time, and possibly to gain necessary macronutrients at the optimal time. We examined whether orangutans exhibited diurnal patterning of feeding bouts using 51 full day follows of wild Bornean orangutans (*Pongo pygmaeus wurmbii*) occurring May 2015 – January 2016 at Gunung Palung National Park, West Kalimantan, Indonesia. While there is a statistically significant difference in food types eaten at different times of day ($x2 = 76.3$, $p = 0.03$), this difference is driven by increased consumption of leaves and pith in the afternoon hours, while fruit is consistently consumed throughout the day. We discuss this in the contexts of optimal nutrient selection and the Geometric Framework of Nutrition.

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The impacts of Cyclone Enawo and anthropogenic disturbances on the habitat of northern sportive lemurs (*Lepilemur septentrionalis*) in northern Madagascar

MARY P. DINSMORE[1], KAREN B. STRIER[2] and EDWARD E. LOUIS JR.[3,4]

[1]Environment & Resources Department, University of Wisconsin - Madison, [2]Department of Anthropology, University of Wisconsin - Madison, [3]Center for Conservation and Research, Omaha's Henry Doorly Zoo & Aquarium, [4]Madagascar Biodiversity Partnership

Madagascar is subject to frequent cyclones, which are thought to have greatly influenced the evolutionary history of Malagasy flora and fauna. However, little is known about their impacts on local forests and ecosystems. Cyclones have the potential to alter forest spatial composition via defoliation, limb damage, and tree falls, and therefore affect primate habitat quality. We had the rare opportunity to study the immediate effects of a cyclone at Montagne des Français (MDF), a dry, deciduous forest in northern Madagascar, and the last remaining home of the critically endangered northern sportive lemur (NSL) (*Lepilemur septentrionalis*). On March 7, 2017, Cyclone Enawo made landfall in northeast Madagascar, with sustained wind speeds reaching 230 km/hr. We resampled 5, 10m x 20m plots within 10 individual NSL home ranges at MDF (~180 miles from the storm's center) to assess tree damage and mortality (2,200 m^2 total). We also quantified anthropogenic threats within MDF to investigate the potential compounding effects of natural and anthropogenic disturbances. We found that of the 1,576 trees sampled, 84% sustained some degree of damage, with limb damage being the most extensive, and emergent trees experiencing higher degrees of limb damage than subcanopy trees. Anthropogenic disturbances varied from 29 to 159 threats/ha across the lemur's home ranges, but the relationship between these disturbances and cyclone damage was nonlinear. These data indicate that although MDF was not in the direct line of Cyclone Enawo, damage was widespread, potentially resulting in long-term alterations to significant food, resting, and sleep trees of NSLs.

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Violent death and the formation of social structure: Skeletal evidence of violence from the Qijia culture (2,300-1,400BCE), Gansu Provence, China

JENNA M. DITTMAR[1], HUI-YUAN YEH[2], ELIZABETH S. BERGER[3], JENNIFER AUSTEN[4], XIAOYA ZHAN[5], MAURICIO HERNANDEZ[6], MAO RUILIN[7], WANG HUI[8] and PIERS D. MITCHELL[9]

[1]McDonald Institute for Archaeological Research, University of Cambridge, [2]School of Humanities, Nanyang Technological University, [3]Lieberthal-Rogel Center for Chinese Studies, University of Michigan, [4]Department of Archaeology, University of Reading, [5]Anthropology Department, Rutgers University, [6]Department of Radiological Sciences, Ronald Reagan UCLA Medical Center, [7]Gansu Provincial Institute for Cultural Relics and Archaeology, [8]Gansu Provincial Institute for Cultural Relics and Archaeology, [9]Department of Archaeology and Anthropology, University of Cambridge

This research examines violence as an essential mechanism for the construction of power structures in early complex societies by examining evidence of violent trauma on human skeletal remains from Bronze Age China. An osteological assessment was conducted on 341 individuals (n=213 adults, n=127 juveniles) from the Qijia Culture that were excavated from the Mogou site, Lintan County, Gansu. The pattern of injuries was recorded on each individual to assess if violence changed over the duration of occupation at Mogou. Only sharp- and blunt-force trauma that was sustained ante- or peri-mortem was included in this analysis. Evidence of violent trauma was found on 4.4% (n=15) of individuals (all adults). No statistically significant difference in the prevalence of trauma between the three phases of occupation (early, middle, late) was identified. Most individuals likely sustained injuries during combat (n=8). However, two males from the late phase of occupation had peri-mortem, sharp-force blade trauma that suggested they were victims of a sacrificial ritual. This was supported by the deviant burial location in the tomb shaft and lack of grave goods. The placement of sacrificial victims within the tomb shaft suggests that sacrifices were made to honor the deceased within the tombs, thus establishing a clear hierarchical relationship between those buried within the tomb and those placed outside of it. This suggests that violence was a legitimate socially constructed cultural performance that was used in the creation and maintenance of social stratification in the Qijia Culture.

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Characterizing whole joint trabecular bone structural variation in the human proximal humerus

LILY J. DOERSHUK[1], JAAP P.P. SAERS[2], COLIN N. SHAW[2], TEA JASHASHVILI[3], ADAM D. GORDON[4], KRISTIAN J. CARLSON[5], JAY T. STOCK[2,6] and TIMOTHY M. RYAN[1,7]

[1]Department of Anthropology, Pennsylvania State University, [2]PAVE Research Group, Department of Archaeology, University of Cambridge, [3]Department of Geology and Paleontology, Georgian National Museum, [4]Department of Anthropology, University at Albany, [5]Department of Cell & Neurobiology, Keck School of Medicine, University of Southern California, [6]Department of Anthropology, Western University, [7]Center for Quantitative Imaging, Pennsylvania State University

The most common method of assessing trabecular bone structural variation involves using one or more Volumes of Interest (VOI) to capture a sub-volume of the total internal trabecular bone structure of a joint. However, there are two main limitations to this approach. First, it is difficult to position VOIs homologously between individuals in terms of both size and location within the joint. Second, even when VOI size is maximized and positioned as accurately as possible, not all of the trabecular bone structure within the joint is included in the analysis, which could mask patterns of variation within or between groups. This project investigates trabecular bone structural variation in the proximal humerus of five human groups with varying subsistence strategies resulting in different levels of mobility and activity. The human groups in this study include mobile hunter-gatherers, horticulturalists,

intensive agriculturalists, and post-industrial individuals. Five proximal humeri from each group were µCT scanned, and trabecular bone structure was mapped across the entire proximal humerus to investigate variation in bone volume fraction (BV/TV) and degree of anisotropy (DA) among the human groups. These data were compared to results from a more commonly-used single VOI analysis. Both methods demonstrate similar patterns of reduced skeletal robusticity in human groups with relatively lower activity and mobility levels, however, differences in BV/TV and DA were observed. Although whole joint analysis is currently limited to qualitative comparison, this method greatly enhances our understanding of variation in modern human skeletal phenotype.

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Revised Criteria for Reducing Observer Error in the Histological Assessment of Linear Microcracks

VICTORIA M DOMINGUEZ[1] and AMANDA M AGNEW[1,2]

[1]Skeletal Biology Research Laboratory, The Ohio State University, [2]Department of Anthropology, The Ohio State University

Validation of methods and counting criteria are an essential, though often overlooked, aspect of histological bone analysis. While clarification and validation has been conducted for some of the most commonly studied variables, i.e. intact and fragmentary osteons, no record exists of validated criteria in the study of linear microcracks. Though rarely studied in the anthropological literature, linear microcracks are a primary aspect of bone microdamage, a field of study essential to the question of bone quality and bone health. Some authors have presented brief descriptions of their criteria for counting microcracks, although this is not the norm and no one in the literature has attempted to validate their criteria or assess levels of intra- and inter- observer error in microcrack quantification. The aim here is to provide revised criteria with an associated photographic atlas illustrating the descriptions as a means to reduce observer error. A preliminary assessment of observer error was conducted using the proposed criteria. Two observers were selected, both trained in bone histology, but only one with experience in microcrack analysis. Each observer assessed the same 10 slides for interobserver analysis and the novice observer assessed all slides twice for the intraobserver study. If the coefficient of variation was less than 10%, error rate was deemed acceptable. Results indicate that observer differences are a serious concern for linear microcrack studies, even with carefully defined criteria, and observer experience is a major factor in reducing error. The criteria and atlas are presented here to encourage discussion for further improvement.

Effects of C-section on the human microbiota

MARIA G. DOMINGUEZ-BELLO

Medicine, NYU

Humans, as well as other animals, have coevolved with microbes that colonize the epithelia, and with an immune system that protects forbidden territories from microbes. The human immune system is currently experiencing increases in disorders, as evidenced by rising asthma, Type 1 Diabetes, allergies, and obesity incidence rates. C-section birth and early introduction of antibiotics have each been associated with increased risk of these modern diseases. This suggests that these early-life factors, which influence the microbiome, are involved in the etiology of these modern diseases. Our lab has shown have shown that C-section significantly alters microbiota composition during childhood, and also that it can be restored by neonatal exposure of C-section newborn to the maternal vaginal fluids. Whether this restoration protects against increased risks of modern diseases associated with C-section is still not known. More broadly, the antimicrobial practices of most urban societies are associated with loss of microbiota diversity as well as metabolite differences. One of the greatest challenges of our time is to modify the modern Western lifestyle and to make it sustainable in order to arrest and prevent the current trends in non-communicable disease. The optimization of human health is best achieved by respecting our evolved biology.

Inflammation as a Mediator of Depression and Diabetes in the Study on global AGEing and adult health (SAGE)

ALLISON C. DONA[1], ALICIA M. DELOUIZE[1], GEETA EICK[1], ELIZABETH THIELE[2], AARON S. RODRIGUEZ[3], BETTY SOLEDAD MANRIQUE ESPINOZA[3], ROBERTO ROBLEDO[4], SALVADOR VILLALPANDO[4], PAUL KOWAL[1,5,6], NIRMALA NAIDOO[5], SOMNATH CHATTERJI[5] and J. JOSH SNODGRASS[1]

[1]Anthropology, University of Oregon, [2]Biology, Vassar College, [3]Centre for Evaluation Research and Surveys (Mexico), National Institute of Public Health, [4]N/A, National Institute of Public Health Laboratory in Cuernavaca (Mexico), [5]N/A, World Health Organization (Switzerland), [6]N/A, University of Newcastle Research Centre for Generational Health and Ageing (Australia)

Diabetes and depression are major global health concerns, affecting over 400 million and 300 million worldwide, respectively. Numerous studies have found that these diseases are commonly comorbid, suggesting the possibility of an underlying shared physiological process such as an inflammatory pathway. As a biomarker of inflammation, C-reactive protein (CRP) has not been consistently linked to these conditions, despite the fact that diabetes and depression have both been linked to inflammatory mechanisms. This study uses Mexico Wave 1 data (n=2340) from the Study on global AGEing and adult health (SAGE) to examine if CRP mediates the relationship between depression and diabetes risk. It is hypothesized that, in participants 50-plus, inflammation will mediate the effect between the two conditions. Depression was estimated using a behavior-based diagnostic algorithm, inflammation was assessed using dried blood spot (DBS) CRP, and diabetes risk was assessed using DBS glycated hemoglobin (HbA1c). The association between depression and diabetes risk was partially mediated by inflammation (indirect effect b = 0.01, p = 0.03). The presence of depression is associated with increased CRP, which is associated with increased HbA1c. This suggests that inflammation may be associated with the comorbidity of depression and diabetes. This may be the first study to use a large sample of older adults in a middle-income nation with high-resolution biomarker information to investigate physiological processes that might be involved in both conditions, an understanding of which could lead to better treatments.

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Anthropogenic disturbance drives critically endangered black-and-white ruffed lemur (*Varecia variegata*) distribution in Manombo Special Reserve

MARIAH E. DONOHUE

Biology, University of Kentucky, Ecology and Evolution, Stony Brook University

Given the severe fragmentation of Madagascar's rainforests, it is becoming increasingly more urgent to identify, assess, and monitor isolated biodiversity hotspots. One such oasis is Manombo Special Reserve (MSR), a patchy complex of humid and littoral forests on the southeastern coast. I aim to build a longitudinal study of MSR's critically endangered and locally endemic lemurs, tracking habitat structure and human disturbance over time to determine the factors driving lemur presence or absence over a relatively small geographic region.

Here, I present baseline data gathered in July 2017. I established four 1-km transects spaced approximately 1-km apart and, in total, detected the presence of two cathemeral (*Varecia variegata* and *Eulemur cincereiceps*) and four nocturnal (*Lepilemur jamesorum, Avahi ramanantsoavanai, Cheirogaleus sp.* and *Microcebus sp.)* primate species. I also created 40x40 m botanical plots at the beginning, middle, and end of each transect to describe forest stature and food species diversity. I found evidence of recent human disturbance, including slash-and-burn agriculture,

hunting, and logging in 9 of the 12 plots. The mean DBH, height, and availability of ripe fruit within each plot did not differ across transects (DBH = 30.6 cm ± 1.24; height = 7.9 m ± 0.50; p = 0.5). Nonetheless, *Varecia variegata* were not detected along transects characterized by the highest degree of human disturbance and lowest food species diversity. These preliminary findings suggest that human forces continue to threaten MSR, and that *V. variegata* exhibit limited ability to occupy suboptimal microhabitats.

I would like to thank Primate Conservation Inc. for supporting this research project.

Identity construction and symbolic association in farmer-vervet monkey (*Chlorocebus aethiops sabaeus*) interconnections in St. Kitts

KERRY M. DORE[1], ANDREA R. ELLER[2] and JACKIE L. ELLER[3]

[1]Anthropology, Baylor University, [2]Anthropology, University of Oregon, [3]Anthropology and Sociology, Middle Tennessee State University

Primates occupy a liminal space between humans and animals. On the Caribbean island of St. Kitts, translocated vervet monkeys (*Chlorocebus aethiops sabaeus*) are respected creatures, yet they cause problems. Vervets regularly consume crops on farms and are considered "pests"; still, Kittitians express empathy and understanding for them based largely on the monkeys' display of human-like behaviors. Using data from interviews with 64 Kittitian farmers, we deconstruct the symbolism of the vervet monkey in St. Kitts and analyze how farmers give the monkeys identities that are meaningful only within human social expectations. Our findings reveal that Kittitian farmers consider monkeys to be clever and emotive, displaying complex intentions such as revenge and remorse. Yet, crop-foraging behavior is a regular and negative experience for the majority of farmers in this study, and the monkeys' presence itself is a constant reminder of the multitude of challenges farmers face in a newly adopted tourism economy that no longer prioritizes agriculture. Our results reveal that while vervet crop consumption is a significant problem in St. Kitts, it is the monkeys' boundary-crossing status that drives the growing mentality that "the monkey problem" is completely out of control.

The various faces of Prehistoric "well-being": the relative effects of sex, age, and population density on dental pathological condition at Neolithic Çatalhöyük (Cental Anatolia, Turkey)

IRENE DORI[1,2], MARCO MILELLA[3], JOSH SADVARI[4], CLARK S. LARSEN[5] and CHRISTOPHER J. KNÜSEL[1]

[1]UMR 5199 PACEA, University of Bordeaux, [2]Department of Biology, University of Florence, [3]Department of Anthropology, University of Zurich, [4]Research Commons Manager & GIS Specialist, The Ohio State University, [5]Department of Anthropology, The Ohio State University

It is generally hypothesized that agricultural intensification, demographic pressure and urbanization resulted in a decrease in well-being. However, these dynamics are usually studied in historic populations; the site of Çatalhöyük (Turkey), due to its long occupation, offers a unique opportunity to investigate changes in well-being within the Neolithic (7100-6000 cal BC). Analyses of dento-alveolar pathological conditions (caries, calculus, antemortem tooth loss -AMTL, and abscesses) provide insights into environmental stressors and diet of past populations, and can shed light on diachronic, sex, and age-related patterns in lifestyle. This study analyzed a large sample (N= 290) of individuals with permanent dentitions by sex and age, and during subsequent occupational phases characterized by varying settlement complexity. Caries and calculus were recorded by tooth location, position and severity; AMTL and abscesses, respectively, by tooth affected and position. Observations were made both by individual and affected tooth. We expected dento-alveolar pathologies and sex-related differences to increase during the phase of greatest site complexity and population density (6610-6250 cal BC). Results by individual show a low prevalence of AMTL (29,7%) and abscesses (4,6%), and high frequencies of caries (51%) and calculus (83,8%). Frequencies of dental pathologies significantly ($p<0.001$) increase with age, with no differences between sexes or occupational phases. While the relationship between dental pathologies and well-being is complex, these results could not detect a worsening in life conditions or sexual dimorphism during the phase of peak site complexity, suggesting that factors other than population density may have been important in determining dental health at Çatalhöyük.

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Hazards of the Industrial Age: Considering Structural Violence in Turn of the Century Milwaukee

SEAN P. DOUGHERTY

Natural Sciences, Milwaukee Area Technical College

The recent introduction of the anthropology of structural violence has provided bioarchaeologists with a framework for understanding the biological effects of marginalization among past populations. What were once viewed as simple disparities of health and status are now linked to more insidious forces that maintain, and enforce, hierarchies of power and status to the detriment of those less fortunate. An examination of a late 19th century poorhouse cemetery population may serve well to display acts of structural violence at the turn of the century. To that end, 985 skeletons excavated from the Milwaukee County Institutional Grounds cemetery (1882-1925) were examined for evidence of trauma. A total of 486 antemortem fractures were observed among 247 individuals, representing 25% of the sample. While many fractures affected locations commonly associated with violent injury, such as the skull, the majority of injuries affected the ribs, hands, and feet. While it is tempting to view the high prevalence of trauma as a feature of poverty, the hidden reality of the poorhouse cemetery is that it received not just the underclass, but those who could simply not afford private burial. As many interred within the cemetery were unskilled laborers, it is likely that a great proportion of these injuries were produced from events involving industrial machinery, transportation, and livestock. Thus, we see in the MCIG sample a community not subjected to the institutionalized violence brought by class or nativism, but by economy and industry. The fractures observed reflect the hazards of life in the Industrial Age.

Being Black and Doing Black Research: Methods for Recruiting and Retaining African-Americans in a Bio-cultural Health Study

JULIUS A. DOYLE, BETTINA SHELL-DUNCAN and STEVE GOODREAU

Anthropology, University of Washington

Given the legacy of racism and exploitation in scientific research, recruiting and retaining African-Americans into well-intended research studies can be difficult (Smith & Blackman, 2013; Lewis, 2003). For potential research participants who are familiar with its history, traditional recruitment efforts can be more likely to deter than attract. Improving inclusion of underrepresented minority groups in biocultural research is critical for such efforts to have relevance and applicability to a broad spectrum of publics. Navigating these tensions has been central to the RHIBA (Resilience and Health in Black America) Project, which involves collection of ethnographic and personal accounts of discrimination as well as hair samples to biomarkers of stress. Experiences drawn from this ongoing project can inform other researchers seeking to improve recruitment and retention of participants from this scientifically underrepresented group.

A first important step is to diversify the research personnel. Research projects should embrace an honest praxis which includes increasing representation and influence within the research team from the communities that such studies are intended to draw upon and serve. Second, a research endeavor should give the participants an active role in something meaningful. Development of the project should include opportunities for feedback and assessment of the goals and methodology by community members.

Third, and most importantly, the study must be transparent. Researchers should be sensitive to participants' concerns about the study, and forthcoming regarding the project goals, personnel, funding sources, future research directions and applications (if any), data sharing, and the disposition of biological samples.

The researcher(s) declare no conflicts of financial interest on behalf of this work.

Pee-mail: The information highway of nocturnal strepsirrhines

CHRISTINE M. DREA[1], THOMAS E. GOODWIN[2] and JAVIER DELBARCO-TRILLO[1]

[1]Evolutionary Anthropology, Duke University, [2]Chemistry, Hendrix College

Among strepsirrhines, urinary scent marking is a prominent form of olfactory signaling in nocturnal species, but tends to be lacking in diurnal species (for which glandular marking is more prominent). This behavioral 'dichotomy' predicts a comparable 'dichotomy' in the chemical composition of strepsirrhine urine: Relative to 'non-urine markers' (non-UM), 'urine markers' (UM) should produce urinary olfactory 'signatures' that are more chemically complex, encode information about the signaler, and have a unique evolutionary trajectory – one that might have selected for specialized pathways or anatomical structures involved in signal production. We used headspace analysis via gas chromatography-mass spectrometry to compare the chemical composition of urine derived (1) from 6 species of UM versus 6 species of non-UM (n=35), and (2) directly from the bladder versus naturally voided by 11 aye-ayes. We found that urine from UM was richer in chemical compounds, contained more putative semiochemicals, and reliably encoded species identity. Pairwise comparisons involving all 12 species showed that the urine of more distantly related species had more dissimilar chemical profiles, consistent with gradual signal evolution. Reconstructing ancestral chemical profiles revealed different evolutionary trajectories for UM vs. non-UM, with minimally four semiochemicals likely present in ancestral nodes leading to extant UM. In-depth study of aye-ayes showed individual differences in the chemical composition of bladder vs. voided urine, suggesting that specific semiochemicals in voided urine might derive from specialized structures along the urogenital tract. Together, these findings are consistent with urine marking being an ancestral behavior that is particularly critical for nocturnal species.

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Regional variability in diet between Northern and Mediterranean Neandertals: Evidence from dental microwear texture analysis

JESSICA L. DROKE[1], CHRISTOPHER W. SCHMIDT[2], FRANK L'ENGLE WILLIAMS[3], WHITNEY M. KARRIGER[4], FRED H. SMITH[5], GAËL BECAM[6] and MARIE-ANTOINETTE DE LUMLEY[6,7]

[1]Anthropology, University of Wyoming, [2]Anthropology, University of Indianapolis, [3]Anthropology, Georgia State University, [4]Anthropology, Tulane University, [5]Sociology and Anthropology, Illinois State University, [6]UMR 7194 CNRS, HNHP, MNHN/UPVD/CERP de Tautavel, France, [7]Institut de Paléontologie Humaine Paris, France

This study employed dental microwear texture analysis (DMTA) to discern dietary differences between Neandertals from Northern Europe (n=8) and those from the Mediterranean region of Southern Europe and the Near East (n=9). The study followed standard DMTA procedures to observe phase II wear facets on molar occlusal surfaces of 17 individuals. Neandertals included in the study were: Arcy-sur-Cure 1, Engis 2, Kebara 2, Kůlna 1, La Quina 5, Hortus III, Hortus IV, Hortus V, Hortus VI, Hortus VIII, Hortus XI, Montmaurin, Pech de l'Azé 1, Spy 1, Švédův stůl 1, Tabūn E2, and Tabūn Series III . The three texture variables, calculated using scale-sensitive fractal analysis software (Sfrax® and Toothfrax®), included complexity (Asfc), anisotropy (epLsar), and textural fill volume (Tfv). Results indicate that anisotropy produced a significant difference between the groups (p = 0.019), with Mediterranean Neandertals showing significantly higher anisotropy values ($\bar{x}$=0.0035) than their Northern European counterparts ($\bar{x}$=0.0019). The Mediterranean values are consistent with previously published DMTA anisotropy values for the Krapina Neandertals ($\bar{x}$=0.0042) and suggest that Neandertals in this region were exploiting fibrous, homogenous foods, such as underground storage organs, grasses, and sedges that required consistent jaw movements. Elevated anisotropy signatures observed in Mediterranean Neandertals across both time and space suggest similar subsistence strategies that coincide with the relative climatic stability of the region and increased amounts of edible plant resources.

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Pathological conditions of craniosynostosis in aboriginal populations from the Gran Chaco plains of northwestern Argentina. A case report

HILTON DRUBE[1,2], SUSANA MARTÍNEZ[2], SUSANA SALCEDA[3,4] and GUILLERMO LAMENZA[3,4]

[1]Facultad de Ciencias Médicas, Universidad Nacional de Santiago del Estero, [2]Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Catamarca, [3]Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, [4]Consejo Nacional de Investigaciones Científicas y Técnicas, CONICET

The aim of this paper is to present a case report of craniosynostosis found in a pre-Columbian population from Argentina. Craniosynostosis refers to the prematural closure of the cranial sutures and is primarily caused by genetic conditions. Scaphocephaly is the most frequent craniosynostosis and implies the early closure of the sagittal suture of the cranium. The skull affected belongs to an individual exhumated in an archaeological site dated in the Late Period of the Pre-Columbian local ceramic sequence, located in the Gran Chaco plains of northwestern Argentina. Macroscopic examination and anthropometrical measurements were performed and X-ray images were taken. Osseous remains correspond to a young male adult. The calvarium is characterized by its abnormal length and narrowness and complete obliteration of the sagittal suture, conforming a typical case of scaphocephaly. Left and right parietals present complete fusion between them, both internally and externally. Cranial vault length and breadth are particularly affected by scaphocephalic conditions and as a result, the skull has a cephalic index lower than 70. No signs of intentional occipital flattening are visible in this case, which was a common cultural practice in ancient societies of this area. The study of congenital malformations such as this case of craniosynostosis is of major importance in the fields of bioanthropology and paleopathology, since it allows to extend the knowledge related to the variety and geographic dispersion of these anomalies in the past and may indicate the degree of susceptibility of a particular population in the suffering of such skeletal disorders.

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Comparative trabecular microarchitecture of the navicular across extant hominids

MADELYNNE M. DUDAS[1] and WILLIAM E.H. HARCOURT-SMITH[2,3,4,5]

[1]Department of Anthropology, University of Texas at Austin, [2]Department of Anthropology, Lehman College CUNY, [3]Division of Paleontology, American Museum of Natural History, [4]Department of Anthropology, CUNY Graduate Center, [5]New York Consortium in Evolutionary Primatology, New York Consortium in Evolutionary Primatology

One of the crucial adaptations related to bipedalism is the longitudinal arch of the foot. The navicular, which lies within the longitudinal arch, is subjected to forces during locomotion as it transfers weight from the talus to the forefoot. Trabecular bone is known to respond to forces by aligning with them and/or by increasing in bone

volume. This study aims to provide a comparative dataset of navicular trabecular bone from which fossil hominin naviculars may be compared in order to provide insights into their relative loading patterns during locomotion.

Navicular microCT scans were obtained for *H. sapiens* (n=11), *Gorilla* (n=9), *Pan* (n=10), and *Pongo* (n=4). The bone volume faction (BV/TV), degree of anisotropy (DA), and trabecular thickness (Tb.Th) were calculated from the segmented trabecular bone in four irregularly shaped regions of interest (ROIs) using BoneJ. These ROIs included trabeculae neighboring the cortical bone where the functional signal tends to be strongest.

The results indicate an increase in DA medially in *H. sapiens* with values greater than those of great apes. This corresponds with more uniform loading observed in *H. sapiens*. In comparison, great apes have a greater frequency of loading reflected in greater BV/TV and Tb.Th within each ROI. Within the navicular tuberosity, which contacts the ground in great apes but not in *H. sapiens,* great apes have a greater DA and BV/TV than *H. sapiens*. Because these results are congruent with known functional differences between these taxa, these results may serve as a useful comparative dataset for fossil hominins.

Craniometric shape similarity in three modern Mexican samples

HAILEY A. DUECKER[1], M. KATHERINE SPRADLEY[2] and VALERIE B. DELEON[1]

[1]Anthropology, University of Florida, [2]Anthropology, Texas State University

The identification of unknown human remains in the Southwest United States has an added complexity with the influx of individuals of Mexican and Central American descent crossing the US/Mexico border. Many of these individuals are dying after crossing the border, and present a unique case to the forensic anthropologist. Craniometric analysis for the estimation of ancestry requires a robust comparative sample for identification, and understanding the variance within comparative samples is vital.

In the present research, 3D cranial landmark data of three Mexican samples were collected using a Microscribe G2X digitizer (Zimapan, Hidalgo, Alfajayucan, Hidalgo, and Merida, Yucutan). Data were analyzed to test for the effects of group on shape. All individuals were scaled to unit centroid size using a generalized Procrustes analysis, and a principal components analysis was used to test for the effects of group on cranial shape. The first principal component primarily separated the Alfajayucan and Zimapan samples, while the second separated the Merida sample from the other two. Despite the two Hidalgo samples being geographically close, there was more variance between the two than between the Hidalgo samples and the Yucutan sample.

These results suggest that Mexicans may be more craniometrically variable than previously assumed. Mexico is a country with a rich history of European contact with different Native American groups. These three samples represent two geographically separated areas of Mexico, with diverse population histories. Understanding the complexity of Mexican craniometric samples can aid in the identification of deceased border crossers in the Southwest United States.

Skeletal inflammatory index: Pursuing experimental evidence

MEGAN E. DUNCANSON and FABIAN A. CRESPO

Anthropology, University of Louisville

An individual's over-reactive immune response may be retained by a balance between costs and benefits of fighting pathogens or different chronic stressors. Individuals who can mount a strong inflammatory response can produce a shift in the systemic levels of inflammatory mediators, which may lead to a potential hyper-inflammatory state or phenotype (HIP). Ultimately, systemic inflammation can influence and increase severity in local inflammatory processes detected in bone lesions or alterations. The objective of this study is to determine *in vitro* if human immune cells pre-treated with inflammatory inducers will affect the inflammatory response against *Porphyromonas gingivalis* (frequently present in periodontal disease-PD) or *Staphylococcus aureus* (frequently present in periosteal lesions-PL and osteomyelitis-OM). During a two-day experiment, we exposed human peripheral blood mononuclear cells to either pro-inflammatory cytokines IFNγ or TNFα, or an inflammatory inducer, LPS, on day one. Sequentially on day two, we exposed the same culture to either *P. gingivalis* or *S. aureus*. The final expression of TNFα and IFNγ was measured by ELISA. Our results showed that early exposure (day 1) to the inflammatory inducers increased the expression of inflammatory cytokines (day 2), especially affecting the inflammatory response to *P. gingivalis*. These findings could be useful in osteological analyses when considering how systemic inflammation may affect local inflammatory responses, and how osteological lesions could be influenced by a HIP. We discuss how the integration of skeletal lesions observed in PD, PL, and OM could help in reconstructing systemic inflammation into what could be called a "skeletal inflammatory index".

Gaits gone wild: spatiotemporal kinematics of tree squirrels (*Sciurus carolinensis*) in laboratory and free-ranging environments

NOAH T. DUNHAM[1], ALLISON MCNAMARA[2], LIZA SHAPIRO[2] and JESSE W. YOUNG[1]

[1]Anatomy and Neurobiology, Northeast Ohio Medical University, [2]Anthropology, University of Texas at Austin

Laboratory research on primate locomotion has provided deep insight into the functional underpinnings of primate locomotor performance. However, laboratories are impoverished substitutes for primates' natural habitats. Here, as a preliminary test of the ecological validity of laboratory data, we compare matching datasets on the gait kinematics of quadrupedal locomotion in captive and wild tree squirrels (*Sciurus carolinensis*), non-grasping arboreal rodents that arguably represent extant vicars of a pre-primate ancestor. We used high-speed video to film 1) three captive squirrels moving on horizontal poles (N=82 strides) and 2) a population of wild squirrels moving on horizontal branches (N=67 strides). Supports were coded as small, medium, or large relative to the animal's diameter. In the laboratory, squirrels responded to decreasing diameter by lowering speed ($p \leq 0.01$), tending to use out-of-phase gaits (i.e., gallops) in favor of in-phase gaits (i.e., bounds) ($p=0.08$), and – controlling for speed – increasing duty factor ($p<0.001$). Like lab squirrels, wild squirrels favored out-of-phase gallops relative to in-phase bounds ($p \leq 0.05$) on smaller supports. However, wild squirrels did not adjust speed ($p \geq 0.58$), or duty factor ($p=0.89$) to support diameter but moved at similar speeds to lab squirrels on small supports ($p=0.10$), and more slowly on large/medium ($p \leq 0.03$) supports. In summary, wild squirrels showed some, but not all, of the diameter-related adjustments seen in the controlled laboratory environment. Future laboratory research should seek to better replicate the heightened variability of natural environments, whereas future research on wild animal gait kinematics should seek to quantify such ecological variation as fully as possible.

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Trabecular architecture across the metacarpus reflects different locomotor strategies in hominoids

CHRISTOPHER J. DUNMORE[1], TRACY L. KIVELL[1,2], DIETER H. PAHR[3,4] and MATTHEW M. SKINNER[1,2]

[1]Skeletal Biology Research Center, University of Kent, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [3]Institute of Lightweight Design and Structural Biomechanics, Vienna University of Technology, [4]Department of Anatomy and Biomechanics, Karl Landsteiner Private University of Health sciences

Plio-Pleistocene hominin hand morphology can be characterised by a mosaic of derived and primitive features that suggest both the potential for increased dexterity as well as arboreal locomotion. However, the adaptive significance of arboreal-related morphology in fossil hominins is still debated. Trabecular bone is able to remodel in response to loading during life via bone functional adaptation and previous studies indicate that trabecular structure in the third ray of extant primates reflects differing locomotor strategies. Therefore fossilized trabeculae offer more evidence with which to reconstruct hominin hand-use than external morphology alone.

Here we build on previous studies by analysing the trabecular structure in the distal heads and proximal bases of metacarpals (Mc) 2-5 in extant great apes (*Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla* and *Pongo* sp.). Micro-CT scans of metacarpals (n=144) were analysed using the whole-epiphysis method. Together, trabecular structure of Mc2-5 suggests relatively consistent loading of the proximal palm across all species studied but differential loading of the distal palm. *Pongo* demonstrates a clear palmar concentration of trabeculae across the metacarpal heads, consistent with a flexed hand posture during arboreal grasping. In *Gorilla* trabeculae are more uniformly distributed within the metacarpal heads consistent with palm-back knuckle-walking. *Pan*, conversely, demonstrates a relatively heterogeneous trabecular structure across the metacarpals consistent with differing functional loading of each digit during palm-in knuckle-walking and arboreality. This evidence is crucial in forming a coherent comparative sample with which to infer hand function in fossil hominin remains, particularly isolated metacarpals.

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Why are women smaller than men?

HOLLY DUNSWORTH

Sociology and Anthropology, University of Rhode Island

Explanations for human body size and strength sexual dimorphism are intertwined with male dominance and are rooted in sexual selection theory. As it is explained across primate species, male-male competition results in bigger, more aggressive males with female preference for these males supporting the process. Consider the gorilla. The more male-male competition, the greater the sexual dimorphism in body size. In "The Woman That Never Evolved" (1981), Hrdy called for a more complete explanation for primate sexual dimorphism than that focused solely on male dominance. Females compete too, so what's keeping them from being larger and stronger? Hrdy's exploration of female competition and dominance among primates rounded out our understanding, but a balanced perspective on sexual dimorphism has not been integrated into the field. Here, as an extension of Hrdy's flipped perspective, the question of human size and strength dimorphism is answered by investigating the differences in rate, magnitude, and types of growth between the sexes in humans and other primates, and by considering the functions, costs, constraints, and tradeoffs involved in producing those differences. The result is a balanced, modern synthesis of proximate and ultimate explanations for sexual dimorphism in human body size and strength, which should broaden the strictly sexual selection-based, male-biased scenario that has long dominated academic discourse and the popular imagination.

Does the Longlin 1 cranium provide evidence for hybridization with archaic hominins in East Asia?

ARTHUR C. DURBAND[1,2,3] and MICHAEL C. WESTAWAY[2]

[1]Department of Sociology, Anthropology, and Social Work, Kansas State University, [2]Research Centre for Human Evolution, Griffith University, [3]Department of Anthropology, Science Centre, South Australian Museum

Resolving questions relating to admixture between ancient hominins and *Homo sapiens* is emerging as a key aspect of research into the evolutionary processes behind modern human origins. The recovery of ancient DNA from extinct hominins is currently rewriting our understanding of how modern humans interacted with archaic populations during the late Pleistocene. Capturing evidence of such admixture in the fossil record has proven to be considerably less straightforward. The hominin fossil record from Asia provides an opportunity to reexamine scenarios of admixture and may clarify the currently murky picture we have of these proposed hybridization events.

Canonical variates analyses of the face and anterior cranial vault are used to compare a variety of fossils from Eurasia, East Asia, and Australasia in an effort to illuminate morphological similarities, and differences, that could be useful for highlighting potential loci of contact between populations. Random expectation statistics of the Mahalanobis distances generated by these analyses will provide a measure of statistical significance.

Results indicate that the early modern East Asians sampled share shape similarities with each other, Eurasian archaics, and other early modern humans. Longlin 1 does have some archaic shape characteristics, but Liujang and the Upper Cave crania exhibit similar patterns. Thus, Longlin 1 fits into the broader pattern of early Holocene evolution in East Asia. The implications that these morphological patterns have for modern human origins will be discussed.

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Landmarking for worn teeth: Comparing methods to evaluate if Type III landmarks measure up

SUSAN J. DYKES[1] and VARSHA C. PILBROW[2]

[1]Evolutionary Studies Institute, University of the Witwatersrand, [2]Department of Anatomy and Neuroscience, University of Melbourne

Dental morphological studies are significant for hominin systematics due to the preponderance of teeth in the hominin fossil record. A major limiting factor is that heavily worn teeth lacking identifiable Type I landmarks are typically discarded from samples although fossil sample sizes are already characteristically small. This is particularly detrimental when the teeth are significant, such as holotypes of species.

We test a methodology based on mathematically-derived Type III landmarks against a traditional methodology using only Type I landmarks for measuring size and shape features of worn molar crowns. Using identical photographs of 255 chimpanzee lower second molars, classification accuracy results are compared from discriminant function analyses of species and subspecies of *Pan*. Average classification accuracy of 67.5% for the mathematical method converged successfully on the 67.8% accuracy of the anatomically-based landmarking methodology, with highest accuracy in classifying *P. paniscus,* and *P. troglodytes verus*, but lesser accuracy and significant overlap between the other subspecies. These results were in keeping with groupings predicted according to molecular and other studies. Three length and width measurements, extremely strongly correlated between methods, contributed significantly to both canonical loadings matrices.

The results provide support for the use of Type III landmarks and mathematically-calculated inputs for shape and size analyses of badly worn fossil hominin molar teeth. Because this method is automated and landmark-based, it is rapid, repeatable and easily adaptable for use in geometric morphometric, Euclidian and other metric analyses while being suitable for all extant hominoid and extinct hominin lower molar comparative analyses.

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Exploring death and dying: Investigations of archaeological hair cortisol concentrations in individuals from Kellis, Egypt

KAITLIN E. EAST[1], LANA WILLIAMS[2] and MICHAEL J.E. GREFF[3]

[1]Anthropology, McMaster University, [2]Anthropology, The University of Central Florida, [3]Robarts Research Institute, The University of Western Ontario

Bioarchaeological assemblages are created and shaped by death, yet this aspect of individual lives and experiences is difficult to assess and remains understudied in bioarchaeology. Hair cortisol concentration (HCC) analysis offers a unique and necessary window into this unique period of time. HCC analysis has been validated in clinical and bioarchaeological studies as a reliable measure of monthly cortisol release associated with biological stress responses. This investigation of a sample of 125 individuals from the Dakhleh Oasis, Egypt reveals significant variation in the patterns of change in HCC in the months leading up to death that does not correspond solely to age or sex. These results indicate that stress may increase, decrease, or remain consistent in the months leading up to death suggesting that dying in the past was a diverse and highly individual experience. Furthermore, in some cases, changes in HCC correspond closely with changes in $\delta^{15}N$ (which studies have shown are highly correlated with metabolic stress), but in others they do not. Together, these findings indicate that HCC analysis provides unique and valuable information about the period around death which could help shed light on a significant time in individual lives as well as the complex forces that shape bioarchaeological assemblages.

Gingival Gene Expression Profiles to Stage Progression of Periodontitis: Of Monkey and Man?

JEFFREY L. EBERSOLE[1], RADHAKRISHNAN NAGARAJAN[2] and OCTAVIO A. GONZALEZ[3]

[1]Biomedical Sciences, University of Nevada Las Vegas, [2]Division of Biomedical Informatics, University of Kentucky, [3]Center for Oral Health Research, University of Kentucky

Human periodontitis is a chronic dysregulated response to a dysbiotic microbiome; expressed temporally as exacerbations and remissions. Similar naturally occurring disease is observed in all nonhuman primate species. **Objective:** We used a nonhuman primate model of ligature-induced periodontitis to identify patterns of the gingival transcriptome that demarcated stages of periodontitis (including initiation, progression, resolution). **Methods:** 18 adult *M. macaca* monkeys (12-22 yrs.) had ligatures placed (premolar, 1st molar teeth) in all 4 quadrants. Gingival tissue samples were obtained at baseline, 2 wks, 1 and 3 mo during periodontitis and at 5 mo reflecting clinical disease resolution. Gene expression was analyzed [Rhesus Gene 1.0 ST Array (Affymetrix)], data normalized, and two-tailed *ttest* performed. **Results:** Baseline samples demonstrated 160 genes that were significantly different than their expression levels at all other time points (92↑;68↓). As would be expected a set of 2823 genes were altered from baseline to 2 weeks (initiation; ~80%↑). Expression of a pattern of 54 genes was unique at 2 wks vs. all other time points. At the 1 mo sampling only 4 genes were significantly different from other time points; however, by 3 mo, 51 other genes had changed significantly. Following clinical resolution (5 mo) 53 genes were altered in expression compared to all other time points and expression of 128 genes was significantly different between the resolved disease ("healthy") and the baseline healthy tissues. **Conclusions:** Unique transcriptomic profiles that occur during the kinetics of periodontitis exacerbation and remission provide biological insights into the dynamics of the disease.

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Morphological characteristics of the "phylogenetically primitive" Liang Bua, Flores, mandibles match past and present regional *Homo sapiens* populations

ROBERT B. ECKHARDT[1], SAKDAPONG CHAVANAVES[1], KENNETH J. HSU[2,3] and MACIEJ HENNEBERG[4]

[1]Laboratory for the Comparative Study of Morphology, Mechanics, and Molecules, Department of Kinesiology, Pennsylvania State University, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Sulan Foundation, Haslemere, United Kingdom, [4]Anthropology and Comparative Anatomy, University of Adelaide

Since the first announcement of their discovery in 2004, the bones from Liang Bua (LB), Indonesia, often have been characterized as phylogenetically primitive. However, LB bones fall into the time range for *Homo sapiens*, whether the original 95,000-120 ka or the revised 100,000-60,000 ka dates, and also are well within more recently-suggested ranges for our species based on 315±34 ka date for Jebel Irhoud. Within those time spans, salient morphological characteristics of the LB1 and LB6 mandibles, for example, can be matched in *H. sapiens* populations of the region. In extant Flores Rampasa, 93.4% have neutral or negative chins (Hastuti & Jacob, 2007). In Eastern Australian aboriginal mandibles (Larnach & Macintosh, 1971), 37.9% show negative chins; internally, a superior transverse torus ranges from slight in 47.7% to marked in 9.8%; digastric fossa ranges from slight in 37.7% to marked in 28.5%. Pertinent comparative data also are provided by the regional fossil record. At Zhirendong, South China (>100 ka), the Zhiren 3 mandible combines corpus robusticity with an inferior transverse torus lingually. From Minatogawa Fissure, Okinawa (19.9-21.8 ka), Mtg 1 exhibits a rounded external chin labially with a lingually large, deep genioglossal fossa demarcating a weak superior transverse torus from a strong inferior torus. Retromolar sulci are found in Mtg A and Mtg C, as well as in Song Keplek 5, a Holocene human skeleton from Java. Hypothetical African Plio-Pleistocene *Homo* ancestry for the LB hominins is unnecessary given the existence of morphologically comparable real human populations spatially and temporally closer.

Examining stress in western lowland gorillas: A multi-zoo application of the first allostatic load index in zoo-housed great apes

ASHLEY N. EDES[1], BARBARA A. WOLFE[2] and DOUGLAS E. CREWS[1,3]

[1]Anthropology, The Ohio State University, [2]Chief Scientific Officer, Morris Animal Foundation, [3]College of Public Health, The Ohio State University

Stress responses maximize survival probability in life-threatening situations. However, repeated and/or chronic stressors generate physiological dysregulation, leading to disease and shortened lifespan. Because stress responses are multi-systemic, they are best studied using integrated models such as allostatic load indices (ALIs). ALIs are composites of biomarkers from multiple systems that estimate accumulated physiological dysregulation, or allostatic load (AL). Previously, we reported on a 7-biomarker ALI (albumin, CRH, cortisol, DHEA-S, glucose, IL-6, TNF-α) in gorillas from one zoo. This research was expanded to additional zoos using two differently pooled samples containing all individuals (n=63). Using α=0.10 due to the exploratory nature of this research and to increase sample size, we tested associations between AL and predictors and outcomes with t-tests, linear regression, ANOVA, and odds ratios. Predictors included sex, age, number of stressful events (anesthetic events, zoo transfers, agonistic interactions with wounding, pregnancies), parity, and rearing history (mother-reared, nursery-reared, wild-caught). Indicators of morbidity (creatinine, cholesterol, triglycerides), age at death, and mortality risk were tested as outcomes. In the first pooled sample, AL was significantly associated with age ($p=0.001$, $R^2=0.155$), rearing history ($p<0.0005$, $R^2=0.231$), triglycerides ($p=0.044$, $R^2=0.096$), creatinine ($p=0.004$; $R^2=0.130$), and age at death ($p=0.009$, $R^2=0.286$). In the second pooled sample, AL was significantly associated with age ($p=0.002$, $R^2=0.139$), rearing history ($p=0.023$, $R^2=0.194$), cholesterol ($p=0.037$, $R^2=0.075$), triglycerides ($p=0.016$, $R^2=0.148$), creatinine ($p=0.001$, $R^2=0.171$), and age at death ($p=0.048$; $R^2=0.155$). Given consistency between our results and those from human research, we

suggest allostatic load indices are a useful tool for investigating health in great apes.

The Columbus Zoo and Aquarium and the Department of Anthropology at The Ohio State University

Spanish/North African population affinity: implications for North American Mestizos

HEATHER J.H. EDGAR[1], KATELYN RUSK[1] and COREY S. RAGSDALE[2]

[1]Anthropology, University of New Mexico, [2]Anthropology, Southern Illinois University Edwardsville

History tells us that Spain was the primary contributor of European genes to the Mestizo (including American Hispanic) population of Mexico and the United States. What are less understood are the origins of the Spanish themselves. Which populations, in what proportions, were contributors to the Spanish of 1492 and later, who left Europe to invade North America? We address this question using evidence from dental morphology, which provides phenetic evidence of population admixture.

Structure was used to analyze data from 65 dental morphological observations representing 10 European and 13 African countries (n=3552) from the 9th century to the present. In eight analyses, the delta-K method identified k=3 and k=5 as optimum numbers of inferred clusters. We find that Spanish samples are more similar to those from Morocco than from other European countries. Spanish samples are also similar to Tunisians. European, West African, and Native Mexican samples were compared with Mestizo samples. Historic Mestizos cluster with Europeans, including Spain and Morocco. However, contemporary Mestizo samples cluster together, separated from their European, African, and Native American ancestors. These results indicate that North African samples should be included in research seeking to link admixed populations in North America with their Old World origins. Further, they provide evidence that secular change and admixture have modified contemporary populations in important ways as compared with their ancestors.

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Matching CODIS genotypes to SNP genotypes using linkage disequilibrium

MICHAEL D. EDGE[1], BRIDGET F.B. ALGEE-HEWITT[2], JAEHEE KIM[2], TREVOR PEMBERTON[3], JUN Z. LI[4] and NOAH A. ROSENBERG[2]

[1]Evolution and Ecology, UC Davis, [2]Biology, Stanford University, [3]Biochemistry and Medical Genetics, University of Manitoba, [4]Human Genetics, University of Michigan

Forensic-genetic work in the United States relies largely on the CODIS markers, a set of 20 (until recently, 13) microsatellite loci in heavy use since the 1990s. One premise that has influenced forensic practice–figuring in discussions of both backward compatibility of SNP-based systems with the CODIS database and of genetic privacy--is that the information provided by the CODIS loci is completely distinct from the information provided by larger sets of single-nucleotide polymorphisms (SNPs). However, there may be a connection between CODIS records and SNP information if pairs of CODIS and SNP genotypes can be identified as coming from the same person--that is, if CODIS and SNP records can be linked. We describe a genetic record-linkage method that assesses whether a particular set of genotypes from the CODIS markers is likely drawn from the same person (or an identical twin) as a set of genome-wide SNP genotypes. The method identifies matches with high accuracy in the presence of hundreds of false distractor matches, with implications for both the plausibility of backward compatibility of a SNP-based forensic database and for genetic privacy.

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Primate zygomatic arch root position in relation to dietary type

HALLIE M. EDMONDS[1], E. SUSANNE DALY[2,3] and IRENE E. SMAIL[2,3]

[1]Center for Evolution and Medicine, Arizona State University, [2]Institute of Human Origins, Arizona State University, [3]School of Human Evolution and Social Change, Arizona State University

Anterior-posterior positioning of the masseter muscle origin (skeletally represented as the zygomatic root), along with other key craniofacial elements, affects the magnitude and efficiency of bite forces generated during chewing. Considerable variation in zygomatic root positioning exists across primates, but is exemplified in the hominin fossil record by the extreme anterior placement in *Paranthropus* and posterior placement in the Neanderthals. Anterior positioning of the root over the premolars in *Paranthropus* is identified as an indicator of dietary specialization for mechanically resistant (i.e., hard and/or tough) foods; however, no broad comparative analysis of arch position and diet in living primates has been conducted. This study tests whether primates that consume more mechanically resistant foods possess arches more anteriorly positioned relative to their dental arcade when compared to those consuming less mechanically resistant (i.e., soft) foods. Zygomatic root position (defined by the landmark zygomaxillare) was determined from digital photographs of skulls for 24 haplorhine primate species. Diet was assigned based on total consumption percent reported in the literature. Pairwise comparisons of closely related taxa were utilized to mitigate the influence of phylogeny when evaluating the association between diet and zygomatic root position, demonstrating zygomatic root position to be relatively more anteriorly placed in the majority of taxa with more mechanically challenging diets ($p<0.05$). Our results support the link between anterior zygomatic root placement in taxa that consume more mechanically resistant foods compared to those taxa consuming softer foods across extant primates.

Developmental pacing in *Macaca mulatta* from two types of managed environments: captive and free-ranging

ANDREA R. ELLER

Anthropology, University of Oregon, Vertebrate Zoology, Mammals, Smithsonian Natural History Museum

Managed nonhuman primate populations offer unique opportunities to study developmental plasticity, especially those with resultant skeletal collections. Osteological developmental data is rare, yet necessary, because variation in the duration and onset of developmental markers elucidates relationships between ecology and growth. Here, I compare the pacing of dental eruption and epiphyseal fusion in subadult *Macaca mulatta* from two types of managed environments: captive and free-ranging. The sample includes rhesus macaques from Cayo Santiago, a free-ranging colony (n=171), and from other US primate research centers (n=183) which utilize more restrictive habitats. Using graded scales to reveal fluctuations in developmental pacing, each tooth was scored based on its eruption stage from "0, unerupted" to "4, fully erupted". Thirty-three epiphyseal fusion sites were scored from "0, unfused" to "2, completely fused". Rates of full dental eruption appear slightly higher in captives (by year 2, 53% of captives and only 29% of free-ranging have fully erupted M1s) yet by year 3, free-ranging animals display higher rates of full eruption in all incisors, molars, and canines. T-tests show that the mean durations of permanent dental eruption are not significantly different between captive and free-ranging groups ($t(33)=0.09$, $p>0.05$). However, the mean durations of epiphyseal fusion in captive macaques ($m=1868$, $sd=764.9$) are significantly longer than in free-ranging animals ($m=1193$, $sd=372.1$; $t(21)=3.19$, $p<0.05$). These results reflect an increased amount of developmental plasticity in postcrania, relative to dentition generally, and suggest that the differences in exercise opportunity between managed populations may impact postcranial development.

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Hominin material recovered from the base of the Chute in the Hill Antechamber, in the Dinaledi Chamber System of the Rising Star Cave

MARINA C. ELLIOTT[1], BECCA PEIXOTTO[1,2], HANNAH MORRIS[1,3], ELEN M. FEUERRIEGEL[1,4], STEVEN TUCKER[1], RICK HUNTER[1], MAROPENG RAMALEPA[1], MATHABELA TSIKOANE[1], ERIC M. ROBERTS[1,5], CARL SPANDLER[5], JOHN HAWKS[1,6] and LEE R. BERGER[1]

[1]Evolutionary Studies Institute, University of the Witwatersrand, [2]Department of Anthropology, American University, [3]Forestry and Natural Resources, University of Georgia, [4]Department of Anthropology, University of Washington, [5]Department of Geoscience, James Cook University, [6]Department of Anthropology, University of Wisconsin-Madison

Currently, the only known access point into the Dinaledi Chamber system of the Rising Star cave is via a narrow, 12m high fracture in the dolostone, known as the Chute (Dirks et al. 2015). Due to its restricted nature, the Chute has been challenged as the primary entrance route for *Homo naledi* bodies entering the system. In particular, Val (2016) and Thackeray (2016) have argued that another entrance must have been present in the past, to explain the volume and density of skeletal remains in the Dinaledi Chamber. However, if an alternate entrance existed, one would not expect to find material at, or near, the base of the Chute. To test this hypothesis, targeted excavations were conducted in the sediment cone below the Chute, in what has been re-named the Hill Antechamber to reflect its distinctiveness from the Dinaledi Chamber. Excavations revealed a dense mass of poorly-preserved skeletal material, as well as multiple well-preserved hominin elements embedded within the mass. Some of the identifiable hominin material is articulated, suggesting a primary depositional context. A small number of avian and microfauna remains were also recovered. The identification of skeletal material at the base of the Chute suggests that at least some of the hominin remains must have entered the Dinaledi system via this route. In addition, the presence of articulated remains suggests the bodies were entering the area at least partially fleshed. These results challenge the idea that another entrance was necessary for the presence of hominin remains in the chambers.

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Subgrouping patterns of lowland woolly monkeys (*Lagothrix lagotricha poeppigii*) at the Tiputini Biodiversity Station, Ecuador

KELSEY M. ELLIS, LAURA ABONDANO and ANTHONY DI FIORE

Department of Anthropology, University of Texas at Austin

A hallmark feature of Atelin primates (genus *Ateles*, *Brachyteles*, and *Lagothrix*) is that they exhibit fluid association patterns, with subgroups changing in size and composition throughout the day. While fission-fusion dynamics have been well characterized for *Ateles* and *Brachyteles*, subgrouping patterns among *Lagothrix* are rather ambiguous. Here, we present data collected July 2014-September 2015 on the grouping dynamics of four groups of woolly monkeys from Tiputini, Ecuador. Every 15 minutes, multiple observers (2-6) evaluated subgroup composition – defined as a subset of individuals that maintained visual or vocal contact with one another and were <100 m from another subgroup member following a chain rule – and recorded the identity/age-sex class of each subgroup member, the location of the subgroup, and subgroup spread. From >10,000 independent group composition records, we found that subgroup membership changed ~3.85 times/day (median: 4, range: 0-11). Subgroups ranged ~474.5 m ± 301.5 m (range: 112 m – 1252.3 m) from one another. Regardless of overall group size, subgroups were usually comprised of 6 adults/subadults, plus dependent offspring. Although a majority of records consisted of mixed-sex subgroups (>80%), nearly 15% were comprised of single- or all-female subgroups, and <5% consisted of single- or all-male subgroups. Subgroups were also formed among members from neighboring groups in >7% of records. While this study highlights the fluid association patterns of woolly monkeys, future research will apply social network analysis to examine how genetic relatedness, reproductive status, and shared space use may influence such dynamic grouping patterns in this species.

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Sexual dimorphism in morphology and reproductive effort

PETER T. ELLISON[1] and RICHARD G. BRIBIESCAS[2,3]

[1]Human Evolutionary Biology, Harvard University, [2]Anthropology, Yale University, [3]Ecology and Evolutionary Biology, Yale University

Sexual dimorphism in morphology is essentially a form of sexual dimorphism in reproductive effort. Sexual dimorphism is elaborated during puberty in response to increasing levels of gonadal steroids interacting with the somatotropic axis and insulin. In all primate species with significant size dimorphism in adulthood, it is the male that exhibits the greater growth spurt at puberty. The degree of size dimorphism corresponds to the degree of male-male competition in reproductive access to females. Monogamous species display little or no size dimorphism.

Size dimorphism in humans is accompanied by dimorphism in many other dimensions and features, notably body composition, biacromial diameter, biiliac diameter, and pelvic morphology. Human males develop and maintain significantly more muscle mass than females, while females develop and defend relatively (though not necessarily absolutely) more fat mass than males. Muscle mass is metabolically more costly to develop and maintain than fat mass. Integrated over the lifespan, this aspect of male reproductive effort represents a cost roughly comparable to the integrated cost of the average female career of pregnancy and lactation. Male muscle mass declines with advancing age as testosterone and growth hormone levels decline. The rate of muscle mass loss in males on average exceeds that in females and represents declining investment in non-parental reproductive effort with age. Males and females thus differ primarily in the temporal pattern of physiological investment in reproductive effort, as opposed to the overall level of investment.

The importance of seeds from non-indigenous trees for chacma baboons (*Papio hamadryas ursinus*) in an anthropogenically altered habitat in Western Cape South Africa

NICHOLAS W. ELLWANGER and THAD Q. BARTLETT

Department of Anthropology, University of Texas at San Antonio

Patterns of activity and dietary strategies can reveal how primates respond to human habitat alteration and availability of non-indigenous foods. This study explores behavioral and dietary strategies of chacma baboons (*Papio hamadryas ursinus*) occupying an anthropogenic habitat in Western Cape, South Africa characterized by indigenous fynbos (evergreen shrubland), grape and olive farms, non-indigenous trees, and colonizing grasses. We followed one group of chacma baboons for a mean of 9 days/month for 10 months. We recorded data on activity, food item selection, and food biomass intake of adult males and females (n=16). We predicted that baboons would spend more time feeding on and consume more biomass of fruit from agricultural parcels than other food types due to a higher biomass intake rate of agricultural fruits. As expected, baboons spent a greater proportion of time feeding in farm and mixed pine-fynbos habitats than in fynbos or exotic vegetation habitats ($p<0.001$; $F=95.96$). However, baboons spent more time consuming foods ($p<0.001$; $F=178.5$) and consumed more food biomass ($p<0.001$; $F=65.82$) from non-indigenous trees than from agricultural fruits, grasses, or indigenous species. Baboons preferentially exploited seeds from a small number of exotic tree species (e.g., *Pinus pinaster, Acacia saligna*) and spent a greater proportion of time ($p<0.001$;$F=640.23$) and gained more biomass ($p<0.001$;$F=85.54$) from seeds than any other plant part. Significantly

more seed biomass came from exotic trees ($p<0.001$;$F=3245.69$) than from any other food type. We suggest that baboons preferentially exploit seeds from non-indigenous trees because these foods provide higher food biomass availability per feeding site.

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Exploring Subsistence Strategies at Helton Using Dental Microwear Texture Analysis

TAYLOR A. EMERY

Anthropology, Loyola University Chicago

For over a decade, dental microwear texture analysis (DMTA) has been used to explore aspects of diet in archaeological populations. The vast majority of the scholarship, however, has focused on permanent dentition. Here, DMTA is performed on the juvenile population within Helton Mound 20 (MNI=22), a Late Woodland mortuary site located in the lower Illinois River Valley. While cultural artifacts and radiocarbon dating place Helton Mound 20 in the latter Late Woodland period, paleodemographic analysis suggests a closer association with the subsequent Mississippian period. It has been hypothesized that the association is due, in part, to a shift in subsistence strategy from foraging towards maize agriculture. Eight individuals had deciduous molars suitable for analysis. Molars were cleaned, molded, and cast following standard procedure; casts were then analyzed using a white light confocal profiler at 100x magnification. Scale-sensitive fractal analysis software was used to calculate complexity (Asfc), anisotropy (epLsar), and textural fill volume (Tfv), yielding mean values of 4.29, 0.0021, and 39539 respectively. As DMTA of deciduous dentition has been limited thus far, only one comparative sample, children from medieval England, was available. It is unsurprising that the medieval sample, which relied primarily on soft, highly processed foods, yielded a significantly lower complexity (1.95) than Helton. While high complexity and relatively low anisotropy values seem to indicate consumption of hard foods such as nuts and seeds, they do not preclude the possibility of the introduction of maize into the diet.

Morbidity and mortality from respiratory infection in wild chimpanzees from Kanyawara, Kibale National Park, Uganda

MELISSA EMERY THOMPSON[1,2], ZARIN P. MACHANDA[2,3], ERIK J. SCULLY[4], DREW ENIGK[1], EMILY OTALI[2], MARTIN N. MULLER[1,2], TONY L. GOLDBERG[5], COLIN A. CHAPMAN[6] and RICHARD W. WRANGHAM[2,4]

[1]Anthropology, University of New Mexico, [2],, Kibale Chimpanzee Project, [3]Anthropology, Tufts University, [4]Human Evolutionary Biology, Harvard University, [5]Epidemiology, University of Wisconsin-Madison School of Veterinary Medicine, [6]Anthropology, McGill University

Fatal epidemics of respiratory disease have occurred in great ape populations across Africa. While significant effort has been devoted to investigating the etiology of these infections, more information is needed on their epidemiology to understand potential demographic impacts. Additionally, respiratory infections are easily observed and thus offer an opportunity to evaluate variation in health across the life course. We examined morbidity and mortality from respiratory infections in the Kanyawara community of wild chimpanzees in Kibale National Park, Uganda. Respiratory disease was the leading known cause of mortality over 30 years, accounting for at least one-quarter of all deaths. We used generalized linear mixed models to examine the predictors of respiratory signs, chiefly productive coughing, over 20 years. A median of 3.7% (range: 0-89.7%) of individuals exhibited signs per month. Contrary to our prediction of weak immune function in both the oldest and youngest individuals, infants exhibited the lowest incidence of infection. Infections were most prevalent among older adults, but males aged 10-20 years also exhibited elevated morbidity. Dominance rank had no effect. In months when individuals were observed with diarrhea, they were 60% more likely to also exhibit respiratory signs. A strong seasonal pattern of respiratory infection was evident but not readily explained by rainfall, dietary quality, party sizes, crop-raiding, or disease in nearby human settlements. Our results suggest that respiratory disease poses a recurring health challenge to chimpanzees in this community and that advancing age is associated with lower resistance to infection.

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Characterizing diet in Bronze-Iron Age Xinjiang and southern Siberian steppe populations through analysis of dental wear, dental disease, and stable isotopes

JACQUELINE T. ENG[1] and MICHELLE MACHICEK[2]

[1]Dept. of Biological Sciences, Western Michigan University, [2]Dept. of Anthropology, Western Michigan University

Recent studies underscore the dietary diversity among early societies of the Eurasian steppe, an expansive, ecologically variable region. This bioarchaeological study focuses on three sites from the eastern and northern steppe to explore questions of dietary variation within and between sites of different periods and locations. Temporal comparisons are made between two Xinjiang sites located in the same area, but from different periods: Bronze Age Tianshan Beilu (n=88) and Iron Age Heigouliang (n=82). The Xiongnu (Iron Age) Ivolga (n=21) site from southern Siberia provides spatial comparison.

Dental wear analysis of adult molars concentrated on M1 given its significantly greater wear than M2 or M3 ($F(2, 243)=73.43$, $p<0.001$ maxilla; $F(2,312)=21.12$), $p<0.001$ mandible) in the Xinjiang samples. Combined data from all sites shows significantly greater mandibular M1 wear among those of older age cohorts ($F(2,71)=4.18$, $p=0.02$), but no significant differences between the left and right sides, the sexes, nor in site comparisons by sex. Dental disease comparisons of site sums demonstrate significantly higher rates of antemortem tooth loss (X^2 (2, N=2448)=66.52, $p<0.01$) and carious lesions (X^2 (2, $N=1719$)=11.07, $p<0.01$) in Heigouliang, while Tianshan Beilu has a higher rate of abscesses (X^2 (2, N=2448)=5.97, $p=0.05$), and Ivolga has a higher rate of enamel hypoplasia (X^2 (2, N=105)=13.68, $p<0.01$). Stable isotope data indicate a range of $\delta^{13}C$ values (-18.34 to -15.09) reflective primarily of C_3 plant input, but there is also marked variation in $\delta^{15}N$ values (12.10 to 15.36). Overall, results are indicative of mixed dietary intake and varied socio-environmental factors between site locations.

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In Search of 'Poetics of Violence' Among the Burials of the Early-Medieval Linear Graveyard of Lauchheim Wasserfurche (Germany)

FELIX ENGEL

Biological Anthropology, University of Freiburg

The Early Middle Ages in Central Europe are commonly regarded as a particularly violent period, mostly because contemporary historiography concentrates on violent deeds by the powerful. Osteological evidence from the large Early-medieval linear graveyard of Lauchheim Wasserfurche (Germany) shows that interpersonal violence involving swords and other weapons occurred regularly but rather infrequently at this rural site. Incidences of violent encounter seem to increase among later burials, though analysis is complicated by heterogeneous material preservation. Burials reflect the introduction of Christian symbolism and possibly the emergence of an aristocracy.

This contribution draws on the 'poetics of violence' concept, as developed by Neil Whitehead, to elucidate social meanings of violent acts evidenced by cases of skull trauma from the Wasserfurche site. Two null hypotheses were challenged: (a) "Interpersonal violence was no constructive social behavior" and (b) "The 'poetics of violence' concept is not helpful in understanding the skeletal evidence".

Evidence from Early-medieval history and the archaeological record were compiled and related to the osteological data, discussing feuding, legal sanctions, burial practices, Christianization and literary topoi related to violence. The micro-sociology of violent confrontations developed by Randall Collins is employed to extend Whitehead's focus on war and other forms of collective violence to the interpersonal level.

As a result, hypothesis (a) was rejected, while this was not possible for (b). However, archaeological and anthropological investigation of the site is incomplete and might yield additional evidence in the future. Strategies for this research are developed in the current study.

Research on skull trauma at the Lauchheim Wasserfurche site was funded by the Gerda Henkel Foundation.

The development of male-female dominance relationships in wild chimpanzees

DREW K. ENIGK[1], MELISSA EMERY THOMPSON[1,2], ZARIN P. MACHANDA[2,3], EMILY OTALI[2], RICHARD W. WRANGHAM[2,4] and MARTIN N. MULLER[1,2]

[1]Department of Anthropology, University of New Mexico, [2]Kibale Chimpanzee Project, Fort Portal, Uganda, [3]Department of Anthropology, Tufts University, [4]Department of Human Evolutionary Biology, Harvard University

Chimpanzee males frequently use aggression in the contexts of competition for status and access to mates. Much of the male aggression directed toward females serves sexually coercive functions. Coercive mate guarding is most effective for mature, high-ranking males since they can use their status and superior strength to successfully intimidate females. Despite smaller body size and lower rank, adolescent males also engage in recurrent aggression against adult females. The primary motivation behind this aggression could be sexual coercion, as in adult males, or the establishment of social dominance over females. Here, we test between these two alternative hypotheses by analyzing 2,865 dyadic aggressive interactions between 12 adolescent males (aged 9-14 years) and 19 adult females during 24 years of observation at Kanyawara in Kibale National Park, Uganda. In support of the social dominance hypothesis, the order in which adolescent males dominated adult females was positively correlated with the females' rank ($r=0.82$, $n=11$, $p=0.002$), such that low-ranking females were dominated earlier than high-ranking females. Furthermore, adolescent males directed more aggression toward females throughout the year prior to dominating them than in the following year (GLMM: $\beta=0.31$, $SE=0.16$, $p=0.048$), suggesting that adolescent males reduce harassment of females that they have clearly surpassed in rank. Our findings indicate that female-directed aggression by adolescent males does not primarily function as sexual coercion. Rather, adolescent male chimpanzees successively target females to climb in social rank, and this process is likely necessary before males begin striving for dominance rank in the adult male hierarchy.

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Possible scurvy at Himera: a differential diagnosis of extensive cranial porosity

VINAYAK ERANEZHATH[1], BRITNEY KYLE[2], KATHERINE L. REINBERGER[3], LAURIE J. REITSEMA[3], STEFANO VASSALLO[4] and PIER FRANCESCO FABBRI[5]

[1]Classics, University of Georgia, [2]Anthropology, University of Northern Colorado, [3]Anthropology, University of Georgia, [4]Regional Archaeological Superintendence, Palermo, Italy, [5]Beni Culturali, Università del Salento

This study discusses bioarchaeological evidence for skeletal stress and possible disease in the population of Himera, an ancient Greek colony in Sicily, by analyzing several cranial, porotic lesions. Many crania of the skeletons at the Greek colony of Himera indicate evidence of porotic hyperostosis and cribra orbitalia; however, some have patters of porosity that extend beyond the expected locations for these conditions. Upon first consideration, the patterns are most consistent with scurvy, a connective tissue disorder caused by Vitamin C deficiency. Current literature is unclear about scurvy diagnosis when porosity is present in less diagnostic areas, absent in characteristic locations of the disease, or when incomplete skeletal remains do not allow for observation at key diagnostic locations. Thus, we differentially diagnose lesions from crania with extensive porosity. To combat the current issues with diagnosing scurvy, we propose a decision tree differential diagnosis that prioritizes certain cranial lesions in order to determine "definite," "probable," and "possible" diagnoses of scurvy and other causes of cranial porosity.

A total of 475 skeletons were analyzed at Himera using established standards. Of 153 individuals observable for scurvy, 49 exhibited signs of extensive cranial porosity. Nine (5.9%) were diagnosed as "definite scurvy," 16 (10.5%) were diagnosed as "probable scurvy," and 24 (15.7%) were diagnosed as "possible scurvy," indicating that scurvy was a disease that affected Himerans. The results of this study contribute to a broader discussion of health and stress, and the possible causes of skeletal lesions at both Himera and in the Mediterranean.

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DETERMINANTS OF FLANGED MALE ORANGUTAN RANGING: ECOLOGY, ENERGETICS, & MALE COMPETITION

WENDY M. ERB[1,2], TATANG MITRA SETIA[3] and ERIN R. VOGEL[1,2]

[1]Department of Anthropology, Rutgers University, [2]Center for Human Evolutionary Studies, Rutgers University, [3]Fakultas Biologi, Universitas Nasional

Male ranging is often assumed to be primarily determined by female distribution, especially in solitary mammals. Whereas ecological and social influences on orangutan ranging have been well documented for females, few studies have investigated factors affecting male ranging patterns. To investigate the factors influencing the ranging patterns of flanged males, we collected behavioral and GPS location data during nest-to-nest follows of 8 adult flanged males from Jul 2013 to Apr 2016 at the Tuanan Research Station in Central Kalimantan, Indonesia. Because flanged males are typically twice the size of adult females, and thus have high energetic demands, we expect that ecological and energetic factors will strongly influence their ranging. We used GIS to generate ranging areas for 5-day follow blocks (N=17) and general linear models to test for the influence of the presence of other orangutans, rainfall, temperature, fruit availability, and the presence of urinary ketones indicating fat catabolism. There was no effect of adult female associations, long calls heard from competitor males, monthly rainfall, or fruit availability on range size, but ranges were significantly smaller during warmer months, and when ketone production was greater. Overall, our results suggest that, at least in the short-term, male range size is most strongly influenced by energetic factors, and appears to be constrained by thermoregulation costs from hot temperatures and during periods of negative energy balance. This work adds to a growing body of work demonstrating the strong influence of energetic stress on both male and female orangutan behavior.

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Patterns of Fluctuating Asymmetry in the Human Axial Skeleton

AMANDINE B. ERIKSEN[1], LAUREN SCHROEDER[2] and NOREEN VON CRAMON-TAUBADEL[1]

[1]Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo, [2]Department of Anthropology, University of Toronto, Mississauga

Fluctuating asymmetry (FA) is the consequence of small, random changes in the development of the left and right sides of an organism, and offers a promising means of understanding the environmental factors that can trigger physiological disruptions. Previous studies of human bilateral asymmetry have often approached the

potential causes of asymmetry with fundamentally different a priori assumptions, resulting in conflicting interpretations. Moreover, most studies of skeletal asymmetry tend to focus on a single region of the body, which limits the ability to understand the causes of asymmetry. This study explores (1) whether FA across different elements of the axial skeleton are correlated and (2) if the sexes differ in terms of patterns of FA. Using a sample of 40 individuals (20 male, 20 female), 3D models of the cranium, mandible, and sacrum were landmarked to calculate FA scores, which were subject to correlation and Mann-Whitney U tests. Contrary to our expectation, results indicate no significant correlation among elements and, therefore, suggest that different axial regions are subject to different asymmetry-inducing pressures. In addition, no systematic differences were found between sexes. While males do appear more variable in FA for the cranium and mandible, results indicate that females display more variability in the sacrum. Most notably, the comparison of individuals with the highest magnitudes of asymmetry indicated that female sacra are significantly more asymmetrical than male sacra, which may be related to parturition. These results suggest that skeletal patterns of asymmetry are generated through different developmental, functional, and behavioral mechanisms.

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Telomere length shortening in early childhood in the Democratic Republic of the Congo

CATHERINE N. ESCOFFIER[1,2], ANDRE M. RICKARD[1,2], PETER H. REJ[3], FELICIEN M. MAISHA[1,2] and CONNIE J. MULLIGAN[1,2]

[1]Department of Anthropology, University of Florida, [2]Genetics Institute, University of Florida, [3]Department of Anthropology, University of Washington

Telomeres are repetitive noncoding DNA sequences at the ends of chromosomes that serve as a buffer for nucleotide loss during cell replication. Numerous studies have found associations between decreasing telomere length, normal aging, and psychosocial stress. Based on relatively few longitudinal studies and comparison of single time point studies, it appears that telomere shortening occurs most rapidly during the first four years of life. However, there are no longitudinal studies of telomere length during this period of early childhood starting at birth. Our study characterizes telomere shortening in a population of children, exposed to extreme prenatal maternal stress, starting at birth and continuing until four years of age.

Blood samples were collected at birth from 100 children living in the Democratic Republic of the Congo with multiple follow-up samples collected at time points ranging from one month to four years after birth. Relative telomere length was determined using qPCR T/S ratio methodology. Data were analyzed using growth curve analysis to create a baseline growth curve for telomere shortening between birth and four years of age. The effect of prenatal maternal psychosocial stress on offspring telomere length through early childhood was also tested. This study is the first to provide longitudinal telomere length data during early childhood and to investigate the effect of maternal stressors on the telomere shortening process.

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Best Practices for Introducing Undergraduate Students to Human Remains Processing

ELIZABETH A. EVANGELOU[1], TESSA SOMOGYI[1], KENNY T. NGUYEN[2], KORTNEY A. WILLIAMS[1] and ELIZABETH A. DIGANGI[1]

[1]Anthropology, Binghamton University, [2]Pathology, Lourdes Hospital

Undergraduate students are often given the opportunity to work with human remains in forensic anthropology labs at universities; often with minimal formal instruction as to how to cope with death and decomposition. Further, scant literature exists discussing the process of introducing students to the experience of macerating human remains. Similarly, institutional guidelines and/or best practices vary by laboratory; and this topic is not covered by Institutional Review Boards. We believe this is to the detriment of the field, as we should ensure that interested students are emotionally prepared for the work required by forensic anthropology laboratories. Here we discuss best practices designed to address this lack of emotional and/or psychological support for undergraduate students working with the recently deceased. The medical literature contains suggestions for introducing undergraduate students to research using embalmed human cadavers; however, due to the complex and often unpleasant nature of human remains processing, our position is that medical literature discussing the subject is not adequate. During our experience processing human remains both for a grant-supported research project and for forensic cases, we first compiled a list of suggested best practices, and then have incorporated these into our standard procedures. These practices include, but are not limited to: gradual introduction to working with fleshed human remains, limiting weekly laboratory exposure, open lines of communication, and positive reinforcement of laboratory/morgue protocols. Here we discuss successes and challenges, and suggest ways other laboratories could implement similar practices.

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Examining African colobine nutrition using improved methods for determining available protein

KATARINA D. EVANS[1,2], WILLIAM J. FOLEY[3], COLIN A. CHAPMAN[4,5] and JESSICA M. ROTHMAN[2,6]

[1]Department of Anthropology, The Graduate Center, City University of New York, New York, New York, [2]New York Consortium in Evolutionary Primatology (NYCEP), New York, New York, [3]Research School of Biology, The Australian National University, Canberra, ACT, 2601, Australia, [4]Department of Anthropology and McGill School of Environment, McGill University, Montreal, Quebec, Canada, [5]Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, New York, New York, [6]Department of Anthropology, Hunter College, City University of New York, New York, New York

Several studies have noted that the protein-to-fiber ratio of the most common mature leaves in a habitat predicts colobine abundance across several forests in Africa and Asia, but there are problems with its application and the mechanism for this correlation is not well understood. Though mature leaves are not usually eaten, it has been suggested that they are a fallback food when preferred young leaves are not available. However, the crude protein (CP) of mature leaves in Kibale National Park, Uganda is 18.0 ± 4.5% crude protein on a dry matter basis (n=112 trees), which is well above the suggested 10-12% needed for maintenance and reproduction. The measure of crude protein only accounts for nitrogen in a plant, but not for its digestibility, nor for any tannins that reduce digestibility. We used an *in vitro* assay modified to stimulate colobine foregut fermentation to measure available protein (AP) and the effect of tannins on the digestibility of leaves that are abundant and/or serve as a predominant food source (n=43 spp.) for two species of colobines (*Colobus guereza*, *Procolobus rufomitratus*) in Kibale. We found that young leaves, the preferred food for these monkeys, contained high levels of both crude and available protein (23.1 ± 6.0% CP, 14.4 ± 6.6% AP), whereas mature leaves, had lower levels of crude and available protein (17.8 ± 4.4% CP, 8.8 ± 4.9% AP). The activity of tannins in mature and young leaves was highly variable across species, reducing available protein by 0-89%.

Next top 3D models - dis/ability and a Romano-British individual with dwarfism from Alington Avenue

STEPHANIE EVELYN-WRIGHT[1], SONIA ZAKRZEWSKI[1], ALEX DICKINSON[2] and CHRIS WOODS[2]

[1]Archaeology, University of Southampton,

[2]Bioengineering Science Research Group, University of Southampton

This presentation outlines the potential of employing 3D printing technology to improve the accessibility of osteoarchaeological research to a wider audience. The project focused on one case study, that of skeleton 766 from the Romano-British cemetery site of Alington Avenue, Dorchester, UK, which exhibited a rare incidence of mesomelic dwarfism. Study of this skeleton forms part of a wider analysis of impairment and disability in Roman Britain. One part of the ongoing study comprises engagement with as wide an audience as possible, including members of the disabled community. Describing the palaeopathology to non-academic audiences, especially visually impaired individuals, was found to be extremely difficult, hence the need for tactile aids was recognised.

This presentation outlines the process and outcomes of the resulting interdisciplinary public engagement project, undertaken by the Archaeology and Engineering departments based at the University of Southampton. The methods used to create the 3D models - including surface and CT scanning - are outlined, as is the feedback received from a preliminary demonstration of the models at the public engagement session held during the 2017 BABAO conference in Liverpool. This project demonstrates a successful, innovative use of 3D printing technology within bioarchaeological study and highlights the potential for interdisciplinary research and public engagement.

The Effect of bi-iliac breadth on thermoregulation during running

JENNIFER EYRE[1,2] and HERMAN PONTZER[2,3]

[1]Anthropology, New York University and the Center for the Study of Human Origins, [2]Anthropology, New York Consortium in Evolutionary Primatology, [3]Anthropology, Hunter College, City University of New York

Birth can be dangerous due to the close correspondence between the size of the neonatal cranium and the maternal birth canal. Potentially the relatively small size of the female birth canal is the result of an evolutionary tradeoff between obstetric capacity and pelvic breadth. The tradeoff was traditionally viewed as being due to selection for effective locomotion. However, a longstanding competing hypothesis, that a narrow pelvis has been selected for in order to effectively thermoregulate, has yet to be empirically tested. A narrow bi-iliac breadth (BIB) may function in thermoregulation by increasing the skin surface area to body mass ratio; the former dissipates heat while the latter produces heat. This explanation presupposes that BIB has a significant effect on the ability to thermoregulate. Here we test if core temperature during running correlates with BIB. 28 subjects (11 females, 17 males) aged 19–44 participated in between one and five 11.3-mile runs at a 0% gradient and a pace of 11.3km/hr. Ambient temperature varied from 10.50–31.65˚C. Subjects ingested an HQInc telemetric temperature sensor and their core temperatures were measured at 0.8-km increments. The data were analyzed using a linear mixed effects model. The model parameters include anthropometric measurements, core temperature readings, and climatic data. Core temperature increases were not significantly correlated with any of the model variables. Thus, variation in BIB is not correlated with thermoregulatory ability in our subjects during high-intensity running in cold to hot ambient temperatures. This challenges the thermoregulation hypothesis, and indicates further testing is necessary.

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In vivo magnetic resonance images of chimpanzee brains suggest that published australopithecine sulcal patterns fall within the range for extant apes

DEAN FALK[1,2], CHRISTOPH P. E. ZOLLIKOFER[3], MARCIA PONCE DE LEON[3], KATERINA SEMENDEFERI[4], JOSÉ LUIS. ALATORRE WARREN[3] and WILLIAM D. HOPKINS[5,6]

[1]Anthropology, Florida State University, [2]Scholars Program, School for Advanced Research, [3]Anthropological Institute, University of Zurich, [4]Anthropology, University of California San Diego, [5]Neuroscience Institute, Georgia State University, [6]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center

In vivo magnetic resonance images from eight adult chimpanzees were processed to visualize and describe their cerebral cortical sulcal patterns. The range of variation in the shape and location of the chimpanzees' sulci and gyri in the frontal lobe was greater than previously documented. Sulcal patterns described in the literature for frontal lobes of australopithecines were revisited in light of these new data and shown to fall within the range of variation for chimpanzees, contrary to earlier reports that certain prefrontal cortical features of australopithecines were derived toward a human condition. The lunate sulcus was displaced more caudally in the occipital lobes of some chimpanzees relative to the sagittal midline than in others. Relative caudal displacement of the lunate sulcus in the chimpanzee sample was associated with the emergence of two annectant gyri (of Gratiolet) that bridge between the parietal and occipital lobes. The second annectant gyrus in apes and humans extends from the angular gyrus (Brodmann's area 39), which, in humans, is important for language. Our findings, combined with comparative research from the literature on the arcuate fasciculus in humans and chimpanzees, suggest that frontal and parieto-occipital regions evolved as an integrated package in hominins. These results imply that language evolution may have been a primary factor in the emergence of the cortical sulcal patterns that distinguish human brains from those of apes.

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Facilitating Practitioner Interaction with 3D Craniofacial Identification Resources

ANTHONY FALSETTI[1], TERRIE B. SIMMONS-EHRHARDT[2], CATYANA RS. FALSETTI[3] and CHRISTOPHER J. EHRHARDT[4].

[1]Mathematical & Natural Sciences, Arizona State University, [2]School of World Studies, Virginia Commonwealth University, [3]School of Geological Sciences & Urban Planning, Arizona State University, [4]Department of Forensic Science, Virginia Commonwealth University

One challenge of craniofacial identification research is producing data/resources that are translatable to practitioners. Traditionally, references have consisted of tables of summarized group data, while training materials have consisted of skulls and facial photos. We have generated three-dimensional (3D) stereolithography models from de-identified, public CT scans from The Cancer Imaging Archives for the collection of measurements between bone and skin landmarks. We have transformed the models to a standard orientation and position relative to Frankfurt Horizontal to facilitate viewing from anatomically relevant angles. In addition to our quantitative data collection of distances, angles, and relative landmark positions, we have generated multiple interactive products, such as a facial feature reference including 2D wireframe plots of bone and skin landmarks, 3D printable models, 3D landmark files, and dense facial tissue depth maps (FTDMs). The 3D FTDMs contain tissue depth values mapped to RGB color values, providing the ability to view and interact with an intuitive color map of depths over the entire facial surface per individual. We have also split the mapped bone and skin points into 1 mm depth increments to facilitate more detailed visualizations of tissue depth variation over an individual face. For the first time, practitioners can visualize and interact with tissue depths simultaneously with craniofacial morphology and anatomical landmarks. However, because practitioners have traditionally not had access to 3D resources, especially in the U.S., we have produced a website with tutorials explaining how to interact with our data utilizing free software, such as Meshlab and 3DSlicer.

National Institutes of Justice

Overview of Dental Disease and Differential Diagnosis Based on Detectable Artifacts of Disease

JAMES P. FANCHER

Anthropology, Texas State University, Dental School, UT Health Sciences, San Antonio

Gathering dental data from human remains using clinical exam techniques can help build solid assumptions on the life history and social/cultural status of deceased individuals that go beyond basic dental feature analysis. Unfortunately, much is often missing for case documentation of human remains in bioarchaeology and forensic settings as there are limits to understanding the provenience and the data from physical examinations.

A set of 133 adult human skeletal remains have been forensically documented for possible identification purposes. The dental analysis included a complete physical and radiographic examination that documented the disease and pathology status. The results indicate that 58% of the individuals had active dental disease at the time of death (caries and/or periodontitis). A variety of other oral pathologies or features were also found that include periapical lesions, retained root fragments, condensing osteitis, impacted teeth, supernumerary teeth, and Tome's roots. While a visible exam found 50 individuals had 103 carious teeth (1-6 teeth per person), the radiographic examination found an additional 52 teeth (combining for 65 individuals total) with incipient or poorly visualized carious teeth, as well as supporting a diagnosis of moderate-severe periodontitis in 28 individuals. Current knowledge of dental pathology, microbiology and the calcified artifacts of dental disease suggest a possible association with the high incidence of disease and the stressful life histories of these individuals. Such theoretical associations may be useful for interpretations of human conditions, past and present, especially at times of human migration.

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Circumorbital rim variation in Western red colobus (*Piliocolobus badius badius*) and its potential role as a sexually selected trait

LUKE D. FANNIN and W. SCOTT. MCGRAW

Anthropology, Ohio State University

Inflation of the bones forming the orbital rim is a characteristic feature of red colobus crania (Genus: *Piliocolobus*). Previous work has demonstrated that variation in this region of the primate face is unrelated to masticatory forces, and while several authors have invoked size or sexual selection as potential explanatory factors, few have tested whether sex differences can explain the feature's variance in a single species. In this study we investigate patterns of circumorbital swelling variation in West African red colobus (*Piliocolobus badius badius*), testing the hypotheses that differences in the extent of rim development are sex, age, and/or size dependent. A sample of 77 crania from Taï Forest, Côte de l'voire was used to collect 11 measurements, including 3 measures of circumorbital development. Adult age was assessed using a tripartite scheme of dental wear: low, moderate, and heavy. Paired t-tests reveal that males possess both absolutely and relatively larger measures of circumorbital ridging than do females. One-way ANOVAs revealed no significant association between dental wear and extent of ridging. Log-transformed bivariate regressions revealed that facial size is a moderate predictor of orbital rim development; however, the extent of ridging in males is generally larger than expectations based on facial size alone, while females have smaller measures than expected. We conclude that circumorbital ridging in *P. badius badius* is a sexually dimorphic trait unrelated to size or age effects. We posit that its variation is explicable via sexual selection, a hypothesis testable with data on female choice and paternity skew.

Medieval urbanisation and nutrition: Secular changes in diet and health at Stoke Quay, Ipswich

ELEANOR C. FARBER, JULIA LEE-THORP and HELENA HAMEROW

School of Archaeology, University of Oxford

The rise of urbanization in medieval England brought opportunities to many levels of society as individuals migrated to urban centers, but also posed health risks due to overcrowding, poor sanitation, and unequal access to resources. While many studies of secular changes in medieval health and diet have been hampered by small samples, or populations drawn from poorhouses, monasteries, or other segregated groups, this study focuses on a parish church cemetery (n=1162) containing both sexes and all ages. The site of Stoke Quay, located in the important medieval town of Ipswich, provides a unique opportunity to analyze a group of "average" individuals, with burials extending over c. 800 years (late 7^{th}-15^{th} centuries AD).

This paper presents the results of stable carbon and nitrogen isotope analysis of bone collagen from 300 males, females and children at Stoke Quay. The isotopic results indicate a population with highly varied diets, with a $\delta^{15}N$ range from 7.5‰ to 16.8‰ (mean 12.8‰ ±1.4), and a $\delta^{13}C$ range from -20.5‰ to -17.5‰ (mean -19.2‰ ±0.6). We observe statistically significant differences between males and females, particularly when individuals are grouped by time period. We evaluate the isotopic data along with osteological indicators of metabolic and infectious disease in this population, to better understand overall health patterns at Stoke Quay. Our interpretations place this site within the context of the published literature, with broad implications for health and quality of life over the duration of the medieval period.

Casts of Laetoli G-Trail Footprints: How informative are they?

MICHELLE L. FARLEY

Anthropology, University of Illinois at Urbana-Champaign, Anthropology, University of Chicago

Anthropologists have classified two features that set humans apart from other animals: a large brain and obligate bipedalism; however, as scientists make more paleoanthropological discoveries, defining these features in the Hominidae family become increasingly challenging. In 1978, the Olduvai Gorge excavation crew uncovered two trails of human-like footprints (G-1 and G-2/3), known as the Laetoli footprints, in a tuff dating to 3.66 Ma in northern Tanzania.Scholars have debated the foot morphology displayed in these prints, the species responsible, and how they relate to human evolution. With few hominid footprints/remains to study, scientists have lacked data and standardized methodologies to assess whether the bipedal kinesiology of the Laetoli hominin is more ape-like or human-like. I used a two-fold approach by examining (1) the foot anatomy associated with different locomotion, and (2) the visibility and taphonomic conditions of each impression, to provide a replicable method for identifying the utility of a footprint based on erosion, pitting, excavation marks, bioturbation, and general features of the toe, arch, and heel regions. For the G-1 trail, I categorized ten prints as useful for analysis of the heel region, eight prints for the arch region, five prints for the lateral digits, and eight prints for the hallux. Based on the lack of undisturbed individual footprints in G-2/3, I advise against the use of this trail for locomotor analysis. With these results, we can assess past morphological interpretations of these useful specimens to construct an appropriate locomotive model for the Laetoli footprints and associated species.

Morphological variation in the pelvis of gorilla subspecies may not track ecomorphological predictions

LAWRENCE M. FATICA[1], ASHLEY S. HAMMOND[1,2], SHANNON C. MCFARLIN[1] and SERGIO ALMÉCIJA[1,3]

[1]Center for the Advanced Study of Human Paleobiology and Department of Anthropology, The George Washington University, [2]Human Origins Program, Department of Anthropology, National Museum of Natural History, [3]Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, Barcelona, Spain

Gorillas habitats range in elevation from zero to 3,850 meters above sea level. Populations living at the highest elevations tend to be less arboreal than lowland populations. These habitat-specific

behaviors make gorillas a unique model to study relationships between locomotion and skeletal morphology in closely related taxa. This relationship has yet to be explored in the gorilla pelvis. We evaluate whether pelvic morphology shows clinal variation from lowland to highland habitats within *Gorilla*. Using 3D geometric morphometrics and principal components (PC) analysis, we analyzed pelvic shape variation across three gorilla subspecies: western lowland gorillas (*G. gorilla gorilla*), mountain gorillas (*G. beringei beringei*), and highland and lowland Grauer's gorillas (*G. b. graueri*). Given the relationship between elevation and locomotion, we expected similarities between highland *G. b. graueri* and *G. b. beringei* and between lowland *G. b. graueri* and *G. g. gorilla*. In particular, we expected differences in the ilium, where several muscles implicated in climbing behavior attach, including the latissimus dorsi, quadratus lumborum, and gluteal muscles. PC1 suggests differences between *G. gorilla* and *G. beringei* in the lateral margin of the ilium, size and shape of the obturator foramen, and pubis orientation. Along PC2, male *G. b. beringei* are distinct in ilium orientation. Highland *G. b. graueri* and *G. b. beringei* occupy opposite ends of PC2, suggesting that habitat-specific behaviors are poor predictors of pelvic morphology in gorillas. Future work will increase sample sizes to better define ranges of variation and test for a relationship between locality elevation and pelvic shape.

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Genome wide data from pre-Columbian South America

LARS FEHREN-SCHMITZ[1], COSIMO POSTH[2], PONTUS SKOGLUND[3,4], BASTIEN LLAMAS[5], WOLFGANG HAAK[2], JOHANNES KRAUSE[2] and DAVID REICH[3]

[1]Anthropology, University of California Santa Cruz, [2]Science of Human History, Max Plank Institute, [3]Department of Genetics, Harvard Medical School, [4]The Francis Crick Institute, The Francis Crick Institute, [5]Australian Center for Ancient DNA, University of Adelaide

The application of genome-wide approaches in paleogenetic research vastly increased our understanding of human population history in recent years, revealing prehistoric population dynamic processes previously undetected when using uni-parentally-inherited genetic markers. Genome-wide data offer a unique opportunity to study interactions between populations through detailed insights into admixture dynamics, including the ability to quantify and date even subtle migration events. However, ancient DNA research addressing regional population histories in South America so far has been mostly restricted to the analysis of mitochondrial DNA (mtDNA) leaving many questions regarding past population interactions between regions unanswered. Here, we report on genome-wide data of over 100 pre-Columbian South Americans dating from ~9000 to 600 BP. The genomic data was obtained by hybridization capture of over 100k SNPs and subsequent High Throughput Sequencing. By comparing our data with published genomic data from modern Native American populations we observe that population structure established early on the continental level and that subsequent gene flow between the major geographic sub-regions was limited. Furthermore, focusing on the data obtained from the Central Andes, we discuss the potential and the challenges to reveal local population histories when studying genomes in populations with low genetic diversity.

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A Geological Context for *Paranthropus* in eastern Africa

CRAIG S. FEIBEL

Anthropology, Rutgers University

Within eastern Africa, fossil specimens attributed to the genus *Paranthropus* have been recovered from localities stretching from southern Ethiopia to Malawi. These fossils range in age from ca. 2.6 Ma to about 1.4 Ma. Landscape analysis of strata that have preserved these specimens provides valuable information related to habitat availability and the environmental dynamics encountered through this time range.

The majority of specimens attributed to both *Paranthropus aethiopicus* and *P. boisei* come from the Turkana Basin of Kenya and Ethiopia. In the Turkana Basin, we can map *Paranthropus* fossil occurrences through more than a million years of landscape dynamics. Early specimens (*P. aethiopicus*) are associated with a major fluvial system (the paleo-Omo) and associated habitats. Subsequent fossils (the *P. boisei* assemblage) are linked to the complex fluvio-lacustrine landscape of the Lorenyang Lake. Here lake margin, deltaic and fluvial settings are closely intertwined. The spatial and temporal dynamics of these savanna mosaics make precise contextualization of individual fossils crucial for understanding habitat associations. Nonetheless, paleogeographic reconstructions help constrain the range of habitat diversity and its variation through time.

Other localities present comparable settings for *Paranthropus* habitats, but with individual distinctions at the basinal scale. Konso is reconstructed as a drier mid-alluvial fan setting, while at Olduvai Gorge, freshwater springs have been shown to be significant, but highly localized, settings. Environmental variability driven by landscape dynamics parallels many aspects of global to regional climatic patterns, suggesting the two may not be easily distinguishable.

Friends of friends: structural network effects predict the formation and maintenance of social bonds in male chimpanzees of Gombe National Park, Tanzania

JOSEPH T. FELDBLUM[1], IAN C. GILBY[2] and ANNE E. PUSEY[1]

[1]Evolutionary Anthropology, Duke University, [2]Institute of Human Origins, and School of Human Evolution and Social Change, Arizona State University

Strong, friendly, and stable social relationships, known as social bonds, are observed in chimpanzees and other non-human primates, and their formation and maintenance is influenced by kinship, dominance rank, and age. However, this picture may be incomplete, as established methods for analyzing social relationships over multiple time periods are unable to account for the non-independence of relationships in complex social groups. To address this critical gap, we employed Stochastic Actor-Oriented Models, a recently-developed technique for modelling changes in longitudinal network data, and investigated the factors predicting social bond formation in adult males from one chimpanzee community. Using a 22-year sample of behavioral and genetic data, we tested the hypothesis that indirect network connections affect the evolution of social bond patterns across periods. In 11 two-year windows, we created a series of binary networks of male social bonds from grooming and association data, and measures of individual and dyadic factors that could influence bond formation (relatedness, dominance rank, rank similarity, age, and age similarity) as control variables. In line with our hypothesis, a preliminary analysis found that triadic closure, the tendency of individuals to form bonds with the bond partners of their bond partners, was a significant predictor of the formation and maintenance of male social bonds (t = 4.35, p < 0.05). When accounting for this effect, none of the tested individual or dyadic factors proved to be a significant predictor of social bonds. This analysis reveals an important and previously unreported factor shaping chimpanzee social structure.

Data collection: Jane Goodall Institute, construction of long-term database: NSF (DBS-9021946, SBR-9319909, BCS-0452315, IIS-0431141, IOS-LTREB-1052693), genetics: NIH (R01 AI058715), Feldblum supported by: NSF GRFP (DGE-1106401) & Leakey Foundation.

Evolutionary and functional implications of the development of the talar posterior trochlear shelf in euprimates

HENRY J. FENG[1], GABRIEL S. YAPUNCICH[1,2], RACHEL H. DUNN[3], ERIK R. SEIFFERT[4] and DOUG M. BOYER[1]

[1]Department of Evolutionary Anthropology, Duke University, Durham, NC 27708, [2]Department of Molecular Biomedical Sciences, North Carolina State University, Raleigh, NC 27607, [3]Department of Anatomy, Des Moines University, Des Moines, IA 50312, [4]Keck School of Medicine, University of Southern California, Los Angeles, CA 90033

The talar bodies of most early euprimates are distinguished from those of other euarchontans by a non-articular, proximally projecting process, known as the posterior trochlear shelf (PTS). A large PTS has been proposed as a leaping correlate, limiting plantarflexion during pushoff. Thus, it has been taken as evidence of a grasping-leaping model of euprimate origins. Alternatively, a large PTS has been interpreted as increasing mobility at the lower ankle joint by increasing surface area for the ectal facet. While the shelf has been qualitatively described, there have been no quantitative comparisons of its variation across phylogenetic and locomotor groups. We quantitatively compare PTS development in a sample representing extant (n=250) and extinct (n=103) euarchontans, derived from microCT scans. Using Geomagic, the lateral tibial facet articular surface was isolated and fit with a cylinder to model the axis of the tibiotalar joint. PTS development was quantified as the ratio of the distance between the axis and the most anterior point in the flexor fibularis groove to the radius of the cylinder. Lorisids and non-euprimate euarchontans have PTS ratios <1 (lack PTS development). Anthropoids have PTS ratios ≈1, while omomyiforms, adapiforms, lemuriforms, and galagids all have PTS ratios >1. Ancestral state reconstruction suggests the euprimate common ancestor exhibited a pronounced PTS. We propose the PTS functions as a cam device, increasing the path length of the flexor fibularis tendons during dorsiflexion, thereby allowing tendon shortening without muscular contraction, and likely increasing the efficiency of pedal grasping on vertically oriented supports.

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Hot headed? The interplay between environmental and biological factors with cranial morphological variation

CHRISTIANNE FERNEE[1,2], SARAH STARK[1] and SONIA ZAKRZEWSKI[1]

[1]Archaeology, University of Southamtpon, [2]Archaeology and Anthropology, University of Bristol

Cranial phenotypic variation is the result of genetic, ontogenetic and environmental factors. This paper analyses the relationship between cranial morphology, environment and biology. Previous studies have employed craniometric measurements to study cranial form. Geometric morphometric methods now enable the detailed capture of cranial shape patterning and analysis of the interplay between environmental and biological factors and cranial morphology.

This paper studies crania from four geographical locations: the mainland United States (n = 100), Alaska (n = 70), Greenland (n = 70) and Australia (n = 42). Different geographical locations were chosen as geography is reciprocally intertwined with climate, subsistence, ecology and population history. Each cranium was CT scanned using a Siemens Somatom Spiral scanner at a resolution of 0.5mm, at 70 μA and 110 kV. Skull shape was studied using an automated geometric morphometric procedure, using 300 surface pseudolandmarks. This data was then analysed using multivariate statistical analyses to study cranial shape variation. Environmental factors incorporated in analysis included climate, altitude, diet. Biological sex was also analysed.

The results illustrate differences in cranial shape between different geographical locations, significant differences found according to climate and diet. These differences indicate cranial morphological plasticity due to dietary adaptation. This is consistent with hypotheses of an interaction between subsistence behaviour and development of the skull, with links made between cranial shape and the transition to farming.

SWW-DTP

The upper limb of *Homo naledi*: New material from the Lesedi Chamber, Rising Star System, South Africa

ELEN M. FEUERRIEGEL[1,2], JEAN-LUC VOISIN[3], STEVEN E. CHURCHILL[2,4], JOHN HAWKS[2,5] and LEE R. BERGER[2]

[1]Department of Anthropology, University of Washington, [2]Evolutionary Studies Institute and Centre for Excellence in PalaeoSciences, University of the Witwatersrand, [3]Unité d'Anthropologie Bio-Culturelle, Droit, Éthique & Santé (ADÉS), Université d'Aix-Marseille-EFS-CNRS, [4]Department of Evolutionary Anthropology, Duke University, [5]Department of Anthropology, University of Wisconsin-Madison

The upper limb of *Homo naledi* has previously been described from fragmentary material discovered in the Dinaledi Chamber in the Rising Star cave system, Cradle of Humankind, South Africa. Recent work at Rising Star has led to the recovery of additional fossil material attributed to *H. naledi* from a new fossil site within the system called the Lesedi Chamber. The new fossil material preserves the upper limb elements from a partial skeleton of a single individual (LES 1). Crucially, the upper limb material from Lesedi preserves functionally significant aspects of morphology missing from the Dinaledi assemblage, including a well-preserved proximal humerus, a complete clavicle, and proximal ulna.

The primitive humeral morphology of the Dinaledi material is replicated within the Lesedi material. Curvature analysis of the Lesedi clavicle revealed that the claviculae of *H. naledi* are similarly primitive, supporting previous interpretations of the *H. naledi* shoulder as being more superiorly positioned than modern humans, and closer to the hypothesized australopith condition. Multivariate analysis of the LES 1 proximal ulna demonstrate the overall similarity of the LES 1 ulna to the KNM-BK 66 ulna from Baringo (provisionally attributed to *H. erectus*). While KNM-BK 66 fell closer than LES 1 to the australopith centroid along major components of variation, both ulnae clustered more with australopiths and Neandertals than with modern humans. These new findings support the presence of *Homo naledi* in multiple depositional contexts within the Rising Star System and provide a clearer picture of the upper limb morphology of this species.

Dental wear through the ages: A Reconsideration of Brothwell's traditional method

SAMANTHA FIELD[1,2], SIMON MAYS[1,2] and SONIA ZAKRZEWSKI[1]

[1]Archaeology, University of Southampton, [2]Archaeology, Historic England

One of the most widely known standards in anthropology is Brothwell's chart for estimating age at death using dental wear. Brothwell claimed that this single chart could be used to estimate age for British individuals dating from the Neolithic to Medieval periods. This requires an implicit assumption that individuals dating from these periods experienced a similar rate of dental wear. This claim, however, has not been verified and dental wear rates from multiple periods have not previously been compared. This is undertaken here using a sample of 281 dentitions (562 teeth) from three samples, ranging in date from the Neolithic (4000 BC) to Medieval (1550 AD).

First and second mandibular molars for each individual were assigned a stage of wear using an ordinal scale based on Brothwell (1963) and Murphy (1959). Evaluation of the gradient between the first and second molars confirmed that rates of wear were similar for these teeth. Application of the Miles (1962) method, which calibrates molar eruption patterns to the amount of dental wear on the molars, based on the observed gradient allowed a period-specific chart to be produced. Comparison of these temporally based wear charts from the three archaeological periods has found a difference in wear rate. This supports developing population specific dental wear charts as these would produce more robust

age estimations than the use of a single wear chart, such as that developed by Brothwell.

Human-nonhuman primate interactions through ecotourism in the Philippines

LORI L. FIELDS

Anthropology, Texas A&M University

Ecotourism is important to maximize the environmental, economic, and social benefits of tourism; however, its consequences must also be taken into consideration. In the Philippines, tourism contributes to economic growth and helps alleviate poverty in many areas of the country. It contributes approximately 9% of the Gross Domestic Product and generates roughly five million jobs; however, nature-based tourism can be destructive to the environment and result in more harm if not properly managed, particularly in island environments. This study examined the role of long-tailed macaques (*Macaca fascicularis*) and tarsiers (*Tarsius syrichta*) in ecotourism on the Philippine islands of Bohol and Leyte. One of the most publicized tourist attractions is the Philippine tarsier. Tourist areas in Bohol are typically the only places people ever see, or learn, about tarsiers, yet misinformation is often disseminated about them. From August 2014-March 2015, I conducted 210 semi-structured interviews, asking about personal knowledge of tarsiers and macaques and their role in tourism. Demographic information was collected from participants in 14 barangays (i.e. communities) and results indicate that while the majority of people were able to accurately identify the habitat in which macaques live, there is still little knowledge about the tarsier's diet and habitat. Understanding people's knowledge about these primates and whether ecotourism is sustainable on these islands, may help inform improved conservation strategies. Results show that people are receptive to community education programs, therefore, implementation of community-based projects in association with these tourist areas may lead to increased sustainability.

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Understanding population variability in age-at-death estimation for modern populations in Mexico and Puerto Rico through the use of 3D laser scans of the pubic symphysis

CRISTINA FIGUEROA-SOTO[1], JIEUN KIM[2], DETELINA STOYANOVA[2], DENNIS E. SLICE[2] and BRIDGET FB. ALGEE-HEWITT[3]

[1]Anthropology, The University of Tennessee, [2]Scientific Computing, Florida State University, [3]Biology, Stanford

One of the main goals of the forensic anthropologist is to aid in the positive identification of unknown human remains by developing a biological profile. Age-at-death estimation is a crucial parameter, but it remains one of the most challenging. Reliable estimation is made difficult by the fact that many traditional methods are dependent upon a set of population-specific criteria that have been mainly developed using individuals of European and African descent. The absence of information on the potential differences in the aging patterns of underrepresented, especially Latino, populations across the U.S. may, therefore, hinder our efforts to produce useful age-at-death estimates. In response to this concern, this study obtained data from individuals of Mexican and Puerto Rican origin to test and update a newly published computational framework for age-at-death estimation from the pubic symphysis for contemporary Hispanic casework. Data for this study consist of laser scans of the pubic symphysis from skeletal collections with known age-at-death at the Universidad Nacional Autónoma de Mexico and the Institute of Forensic Science in Puerto Rico. Each scan was subjected to the Slice and Algee-Hewitt(SAH), Thin Plate Spline/Bending Energy (BE), and Ventral Curvature (VC) methods. Preliminary analyses, using paired t-tests, find no significant differences between known and inferred age-at-death ($0.03 \leq p \leq 0.71$) after Bonferonni correction. Results do suggest a tendency for the VC and BE methods to underestimate age for individuals over 65 years. This study has confirmed that reliable age-at-death estimates can be obtained for Hispanic groups using these computational methods.

Neonatal and postnatal mortality in Roccapelago through the study of human skeletal remains and parish records

CARLA FIGUS[1], MIRKO TRAVERSARI[1], LUCIA M. SCALISE[1], LAURA BUTI[1], ANTONINO VAZZANA[1], RITA SORRENTINO[1,2], GREGORIO OXILIA[1,3] and STEFANO BENAZZI[1,4]

[1]Department of Cultural Heritage, University of Bologna, [2]Department of Biological, Geological and Environmental Sciences, University of Bologna, [3]Department of Biology, University of Florence, [4]Department of Human Evolution, Max Planck Institue for Evolutionary Anthropology

During the restoration of the Conversion of San Paul's church, in Roccapelago (Italy), a hidden crypt was brought to light. Therein, a large amount of human skeletal remains was retrieved, including a considerable amount of disarticulated non-adult specimens, belonging to the inhabitants that lived there from the last decades of the 16th century to the end of the 18th century. Simultaneously, parish registers of birth and death were found and digitized. This is the first study focused on the juvenile post medieval community of Roccapelago, which aims to provide new data about infant mortality and paleopathology during the 16th and 18th centuries, through the comparison of anthropological data to information available in parish records.

Standard anthropological protocols were used to assess the Minimum Number of Individuals, age-at-death and pathologies.

Results showed that at least 161 non-adults were buried into the crypt. The mortality range was high among perinates, especially between the 36th and the 40th weeks (26%), and during the first postnatal year, particularly in the first six months (11%). Then, mortality rates fell within the 5th years (2.4%). Parish records confirmed the high mortality rates at birth and among the first postnatal year, linked to the risks associated to the birth and the peril of the weaning period. The pathological analysis highlighted the presence of metabolic diseases, such as scurvy.

This study provides a unique opportunity to compare anthropological protocols for age estimation to the information registered in the parish records when dealing with commingled juvenile remains.

Proxies of ungulate diet reconstruct the paleoenvironment of *Australopithecus afarensis* at Laetoli, Tanzania

ELIZABETH N. FILLION[1], DENISE F. SU[1,2], AMANDUS KWEKASON[3] and TERRY HARRISON[1]

[1]Center for the Study of Human Origins, Department of Anthropology, New York University, [2]Department of Paleobotany and Paleoecology, Cleveland Museum of Natural History, [3]National Museum of Tanzania

Inferences about paleoenvironments are critical for modeling the selective pressures that led to adaptive shifts and divergence events in the hominin lineage. Reconstructions of the paleoenvironment of *Australopithecus afarensis* in the Upper Laetolil Beds (~3.85-3.63 Ma) indicate that it was a mosaic of woodland, shrubland, and grassland. Analyses of three independent proxies of ungulate diet (hypsodonty, mesowear, and $\delta^{13}C$ of tooth enamel) show that obligate grazers were rare among the ungulate fauna of the Upper Laetolil Beds. The proportion of browsing to grazing taxa is most comparable to modern African communities that inhabit forests and closed woodlands. A distinctive feature of the ungulate fauna is the predominance of species classified as mixed feeders, which represent a higher proportion of taxa at Laetoli than in any modern-day African habitat. It is unclear whether this indicates that the Laetoli ungulate fauna had a unique composition or is an artifact of the methods used to infer diet. Nevertheless, the results do show that species which incorporated browse into their diets were more common at Laetoli than in modern ungulate communities living in woodland-grassland habitats. This

implies that the ecological relationships and the types of woodland mosaic habitats that supported a diverse guild of browsing ungulates in the Pliocene no longer occur today.

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Interface distances between osteon cement lines can reveal aspects of bone adaptation that might evade detection when using conventional microstructural characteristics: A study in the chimpanzee femur

ETHAN D. FINLINSON, MARSHALL K. HENRIE, JAMES S. SMITH, CHAD S. MEARS, KENDRA E. KEENAN and JOHN G. SKEDROS

Orthopaedics, University of Utah

When osteon population density (OPD) is sufficiently high, osteon cement lines (CL) can enhance the bone toughness. CL help deflect microcrack propagation, which helps avoid fracture. We examined potential manifestations of the role of cement lines as "toughening entities" using a novel approach; namely, quantifying the total amount of cement line (tCL) and intercement-line interface (CLi) distances between bone regions where such adaptations would be most likely. Measurements were made in 50x circularly polarized light images of thin sections of medial and lateral cortices of upper diaphyses in eight adult chimpanzee femora. In this region: (1) the medial cortex receives prevalent/predominant compression vs. tension in lateral, and (2) compared to loading in compression, bone is weaker, less tough, and less fatigue resistant in tension. In addition to CLi distances and tCL, we quantified OPD, fractional area of secondary bone (FASB), osteon size (On.Ar), osteon shape (elongation index), predominant collagen fiber orientation (CFO), and osteon morphotype score (OMS, indicates compression vs. tension adaptation). Compared to the lateral(tension) cortex, the medial(compression) cortex had enhanced matrix adaptation (CFO and OMS) for compression and less tCL, lower FASB, and smaller/more elongated osteons (all $p<0.01$). CLi distances and OPD were not different ($p>0.1$), possibly reflecting optimization for inhibiting microcrack propagation. In contrast, matrix-level differences (e.g., CFO and OMS) might be aimed at inhibiting microdamage formation. These different adaptations might not be detected when considering conventional microstructural characteristics. Though rarely considered, these different goals of microstructural variations are important for understanding how bone toughness is achieved.

Diet and cultural diversity in Neanderthals and modern humans from dental macrowear analyses

LUCA FIORENZA[1,2], STEFANO BENAZZI[3,4], ALMUDENA ESTALRRICH[5,6] and OTTMAR KULLMER[7,8]

[1]Anatomy and Developmental Biology, Monash University, [2]Earth Sciences, University of New England, [3]Department of Cultural Heritage, University of Bologna, [4]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [5]Instituto Internacional de Investigaciones Prehistóricas, Universidad de Cantabria, [6]Paleoanthropology Group. Department of Paleobiology, Museo Nacional de Ciencias Naturales, [7]Department of Palaeoanthropology, Senckenberg Research Institute, [8]Department of Paleobiology and Environment, Institute of Ecology, Evolution, and Diversity, Johann Wolfgang Goethe University

Neanderthals have been traditionally described to be at the very top of the food chain, with a diet consisting almost exclusively of meat. On the other hand, anatomically modern humans (AMH) are thought to be a more flexible species with the exploitation of various food sources. Here we analyse dental macrowear of a large sample of Neanderthal and AMH postcanine teeth from different chronological and geographical areas of Europe and the Near East, applying a well-established method called Occlusal Fingerprint Analysis (OFA). This digital approach is based on the identification and analysis of attrition and abrasive occlusal wear facets (defined as polished homologous areas with well-defined borders) with the aim to reconstruct the jaw movements responsible for their formation. Thus, it enables to obtain information on dietary and non-dietary habits of these populations. Wear facet size and distribution seem to correlate well with diet, showing a large variation within Neanderthals and AMH, which mostly depends on the habitats they inhabited. We found ecomorphological signals distinguishing populations who lived in cold habitats from those who inhabited warm climatic conditions, suggesting an increase in meat consumption at the northern latitudes. In contrast, wear facet inclination is strongly influenced by the environmental abrasiveness accidentally introduced in the mouth through food preparation methods. In addition, we have also identified non-dietary wear on the postcanine dentition in Near East populations that suggests the use of teeth as tools for daily task activities.

Assessing gum availability in bushbaby (*Galago moholi* and *Otolemur crassicaudatus*) habitat at Loskop Dam Nature Reserve and Leshiba Wilderness Reserve, South Africa

KRISTA FISH[1], CLAIRE BRESNAN[1], IAN RAY[2,3] and BRANDI WREN[1,3]

[1]Anthropology, Colorado College, [2]Education, University of Denver, [3]Primate Studies, Sepela Field Programs

Developing methods to assess availability of tree exudates is a priority for researchers studying primates that utilize gums as a food source. Between 1 June and 10 July 2017, we explored two methods for assessing and monitoring gum availability. At Loskop Dam Nature Reserve, home to southern lesser bushbabies (*Galago moholi*), we established sixteen 25 x 10 m plots. Within each plot, we examined each acacia tree (*Vachellia* spp.) for gum and evaluated potential cause of damage (e.g. vertebrate animal feeding, insect activity, fire) leading to gum production. In each plot, we measured variables including acacia tree DBH, number of acacia and non-acacia trees, and soil quality. We also constructed four 25 x 10 m plots at Leshiba Wilderness Reserve which is inhabited by both southern lesser bushbabies and thick-tailed bushbabies (*Otolemur crassicaudatus*). At both sites we utilized an acacia gum farming method to create a 5 cm x 5 cm cut in six acacias to monitor the tree for gum flow.

Plots that had the most evidence of vertebrate animal feeding, including possible primate feeding, were not associated with tree dbh or soil quality. The only relationship detected was between vertebrate feeding and number of acacia trees, particularly *Vachellia karoo,* in a plot. The acacia gum farming method stimulated gum flow that could be monitored for output in some, but not all trees. We discuss factors impacting gum flow on these trees and techniques to enhance method reliability.

This study was funded by a Colorado College Social Sciences Executive Committee Grant, a Colorado College Faculty-Student Collaborative Grant, and Sepela Field Programs.

Fossil Primates from the Miocene Pinturas Formation, Santa Cruz, Argentina

JOHN G. FLEAGLE[1], MARCELO F. TEJEDOR[2] and NELSON M. NOVO[2]

[1]Anatomical Sciences, Stony Brook University, [2]Instituto patagónico de Geología y Paleontología, CENPAT

Fossils were first discovered from the valley of the Rio Pinturas in the northwestern corner of Santa Cruz Province, Argentina, by Carlos Ameghino in 1891. They weresubsequently described by his brother, Florentino Ameghino. In the 1980s and early 1990s, expeditions from Stony Brook University and the Museo Argentino de Ciencias Naturales (MACN) made extensive collections

from several horizons in the Pinturas Formation leading to the discovery and description of two genera, *Soriacebus* and *Carlocebus,* and four species of platyrrhine primates.

Subsequent expeditions from the Centro Nacional Patagonico (CENPAT) in Puerto Madryn and the Laboratorio de Investigaciones en Evolution y Biodiversidad at the Universidad Nacional de la Patagonia in Esquel have expanded our knowledge of the fossil primates from this formation and confirmed that the primate diversity in the Pinturas Formation is greater than previously described. In particular, the Cerro de Los Monos locality shows considerable size diversity among the platyrrhine fossils.

The Pinturas Formation from southernmost Argentina has the second greatest diversity of fossil platyrrhines of any paleontological area in all of South America, exceeded only by LaVenta in Colombia. Paleontological research in other parts of South America have revealed additional fossil primates related to those first described from the Pinturas Formation.

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Corporeal affect: human remains as subjects and objects in Cambodia

JULIE M. FLEISCHMAN

Forensic Anthropology Division, Harris County Institute of Forensic Sciences

This presentation will discuss the conceptions of human remains resulting from the Khmer Rouge (KR) period (1975-1979) as both active materials (objects) and as embodied memories (subjects) in modern Cambodian culture. This research embraced a biocultural approach to move beyond traditional osteological research by addressing the social impact of skeletal remains.

While an osteological analysis of remains from mass violence provides demographic and traumatic injury data, without integrating the sociocultural context, these remains persist as isolated specimens of scientific or historical evidence. Therefore, this research evaluated the incorporation of human skeletal remains into memorial *stupa* (shrines). Primarily employing the theory of human remains' affective materiality and agency, I evaluated observational and interview data from 13 memorials to assess what the enshrined skeletal remains provoke, constrain, and/or permit regarding the memory of KR violence.

Ten interviews were conducted and all informants indicated that the bones (as objects) can and should be displayed, primarily with the intent of informing visitors and the younger generations about the violence inflicted by the KR. However, the human remains are also subjects to be respected, commemorated, and cared for. Many informants expressed the need to pay homage to the remains, ancestors, and spirits. The bones therefore provoke and invoke interactions with the living; they are not merely inanimate objects to be displayed and relegated to the past. The remains enshrined in Cambodian memorials are corporeal agents serving as a reminder of violence and loss, yet interacting with, and requesting things of the living in the present.

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Bruxism: Prevalent Pathology, Problematic Paleopathology

ALLISON J. FOLEY

Sociology and Anthropology, College of Charleston

Bruxism is a behavioral disorder characterized by the unconscious clenching and/or grinding of teeth. Primarily thought of as a sleep disorder, bruxing is also a common waking parafunctional activity and its two forms, Awake and Sleep Bruxism, are comparatively different in their characteristics, etiologies, and demographic distributions. Both forms of bruxism are common; periodic episodes affect 20-31% of adults, and 15-20% of children are frequent bruxers. Though the frequency of bruxing decreases with age, unchecked, long-term engagement with the behavior can result in serious dental pathology. Dental attrition, abfraction, fracture, and occlusal pitting have all be associated with bruxism, as have hypercementosis, myofascial pain and hypertrophy of masticatory muscles.

Though receiving substantial, modern clinical acknowledgement, bruxism is rarely discussed in the paleopathological literature. Considering its modern prevalence and the pathological patterns associated with it, bruxism should be visible in archaeological human remains, yet, thus far, the creation of a distinct differential diagnosis has proven to be prohibitively challenging. Evidence of bruxism may easily be obscured or exacerbated by masticatory and/or behavioral wear, environmental erosion, malocclusion, tooth-loss, and enamel defects. Biomechanical forces associated with clenching, grinding, or a combination of the two behaviors may also present idiosyncratically, adding further ambiguity to the diagnostic process.

Despite these challenges, this presentation will argue that the paleopathological examination and acknowledgment of bruxism is a potentially fruitful avenue of research and will suggest some diagnostic criteria that may aid in identifying bruxism in skeletal remains.

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Hidden in plain sight: How census-level data mask health risks in urban mobile home communities

ALLISON B. FORMANACK[1] and RICHARD L. BENDER[1]

[1]Anthropology, University of Colorado Boulder

Mobile homes are restricted to private lands operated as for-profit businesses in most American cities. As such, mobile home community (MHC) residents experience a unique form of housing tenure which simultaneously classifies them as owners (of homes) and renters (of land), however MHCs are not marked within census tract (CT) data. In MHCs, reliance on landlords to maintain private infrastructures can reduce community health and wellbeing as routine repairs are neglected for increased profits. Here, we show how public health approaches that rely on CT data to identify at-risk populations obscure the sociolegal and health anomalies of MHCs. Drawing from 28 months (2011-17) of fieldwork in Lincoln, Nebraska, we argue that although CT data are intended to represent homogenous communities, they instead erase spatial heterogeneity in health risks. For instance, across all Lincoln CTs (N=64), poverty rates are negatively associated with homeownership rates (r=-0.86, p<0.001) and life expectancy (r=-0.61, p<0.001). However, in the 8 CTs containing MHCs these measures lose significance (r=0.02, p=0.96; r=-0.10, p=0.82), suggesting that conventional assumptions about homeownership, poverty, and health do not adequately characterize MHCs. Additionally, Lincoln MHC residents pay 1.5-1.8 times as much for water/sewage services than the citywide averages due to private ownership and (lack of) maintenance of water infrastructures, but again, this MHC health risk is invisible in CT data. Such data are problematic as public health tools in this context, because they cannot identify MHCs and therefore fail to account for the distinctive sociolegal structures generating observable health risks in these communities.

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Morphological variation of the modern human sacrum with implications for early hominins

CINZIA FORNAI[1,2], MARTINA NUEESCH[1], VIKTORIA A. KRENN[1,2] and MARTIN HAEUSLER[1]

[1]Institute of Evolutionary Medicine, University of Zurich, [2]Department of Anthropology, University of Vienna

Owing to its central role in childbirth, the human pelvis shows marked sexual dimorphism. The degree of pelvic morphological heterogeneity in relation to body size and ancestry is not fully known, and the contribution of the different anatomical components to its variation,

particularly throughout human evolution, is unexplored. The female sacrum is typically described as broader, shorter, and more curved than in males, contributing to a pelvic canal configuration more suited to birth. Early hominin sacral morphology can best be assessed in *Australopithecus africanus.* Sts 14, a probable female shows very wide sacral alae relative to the S1 corpus, whereas the probable male StW 431 has relatively narrow alae.

Our modern comparative sample is based on osteological and patient data from individuals with known sex and geographical origin from Central Europe, Southern Asia, and Africa, including small-bodied populations. Using geometric morphometrics, we investigated shape and size differences based on a dense configuration of landmarks and curve semilandmarks.

Our results confirmed that length-to-width and S1 corpus-to-alae proportions best distinguish between sexes. Conversely, sacral curvature is not sexually dimorphic, although females show lower variation. High heterogeneity was detected at the sacral alae, possibly because of their moderate influence on reproductive success. Furthermore, regression analyses revealed that size and ancestry have negligible effect on sacral shape. Finally, we compared modern human sacral morphology with that of StW 431 and Sts 14, and discuss the implications for sexual dimorphism, birth and taxonomy in these early hominins.

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Do trabecular properties signal a bipedal loading pattern in a rat model for the quadrupedal to bipedal transition?

ADAM D. FOSTER[1], REBECCA W. COOK[2], BRIANNA WHITHORN[3] and JAXON VALLELY[3]

[1]Department of Anatomy, Campbell University School of Osteopathic Medicine, [2]Department of Molecular Biomedical Sciences, North Carolina State University, [3]OMS, Campbell University School of Osteopathic Medicine

One common method for interpreting signals of locomotor behavior in extant and fossil taxa is through analysis of trabecular bone properties, typically through a set of variables including degree of anisotropy (DA), thickness (Tb.Th), and connectivity (Conn.D). Previous work suggests that these variables can distinguish locomotion-specific patterns across taxa. However, very little is known about how trabecular bone responds to differing mechanical loads within the same taxon. In particular, experimentally testing how transitioning from a quadrupedal to bipedal loading pattern impacts trabecular properties can provide key data for generating predictions to detect signals of bipedalism in fossils of the earliest hominins.

This study utilizes a novel method to experimentally induce a locomotor shift during ontogeny in a rat model. Rats (n=14) were placed in a custom harness system mounted on a treadmill which allowed for controlled bipedal locomotion over 60 minute periods, five days a week, for three months, starting at four weeks of age. The harness imparts an adjustable upward force on the torso which alters the load experienced by the hindlimbs. A quadrupedal control group that was exercised for the same period acted as a control. At the end of the experiment, µCT scans were used to measure DA, Tb.Th, and Conn.D in the distal femur and tibia using BoneJ. Using a linear mixed-effect model, significant differences were found in the distal tibia in Conn.D (p=0.05), with Tb.Th approaching significance (p=0.07). These preliminary results suggest that signals of bipedal locomotor behaviors are detectable within the same taxon.

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Macrowear and Tooth Enamel Mechanical Properties

FREDERICK R. FOSTER[1] and PAUL J. CONSTANTINO[2]

[1]Department of Anthropology, Rutgers, the State University of New Jersey, [2]Department of Biology, St. Michael's College

Dental Macrowear occurs when the amount of enamel removed is evident to the naked eye. It typically proceeds with the gradual rounding of cusps before flattening and dentine exposure. The degree of macrowear can be scored and used to identify population differences related to diet. Though excessive macrowear can compromise the utility of a tooth, many mammalian species rely on a degree of enamel wear to maintain tooth functionality. Thus, the factors affecting macrowear hold important information about dietary adaptation. The loads required to cause wear are described mathematically as a function of the mechanical properties of enamel. These properties include the elastic modulus and hardness, which vary by location and direction within a tooth. Here, we review previous research exploring the link between macrowear and mechanical properties, and implicate the angle between enamel prisms and the occlusal surface as an important factor in wear-resistance. This angle changes as macrowear accrues which affects the mechanical properties, and in turn has implications for further wear-resistance. To explore changes in wear-resistance with macrowear, we test the hypothesis that mechanical properties at the occlusal surface will change as crown height is reduced. We use nanoindentation and helium ion microscopy to map the mechanical properties and microstructure of enamel in a baboon molar as its cusp height is reduced. Our results show how hardness and elastic modulus differ with degree of wear at the occlusal surface, and add to our understanding of the role these properties play in resisting macrowear.

Research for this project was funded by a grant from the Center for Human Evolutionary Studies, Department of Anthropology, Rutgers, the State University of New Jersey.

Isolation, Antibiotic Resistance and High Co-colonisation of Human Pathogens among Human-Habituated Wild Monkeys in The Gambia

EBENEZER FOSTER-NYARKO[1], BRENDA A. KWAMBANA-ADAMS[1], MADIKAY SENGHORE[1,2], JAINABA MANNEH[1], MICHEL DIONE[1], ANNA J. JASINSKA[3], CHRISTOPHER A. SCHMITT[4], JENNIFER D. CRAMER[5], TRUDY R. TURNER[6,7], GEORGE WEISTOCK[8] and MARTIN ANTONIO[1,2,9]

[1]Vaccines and Immunity Theme, Medical Research Council The Gambia Unit, [2]Division of Microbiology & Immunity, University of Warwick, Coventry, United Kingdom, [3]Institute for Neuroscience and Human Behaviour, University of California Los Angeles, Los Angeles, California, USA, [4]Center for Neurobehavioral Genetics, University of California Los Angeles, Los Angeles, California, USA, [5]School of Arts and Humanities, American Military University and American Public University, Charles Town, West Virginia, USA, [6]Department of Anthropology, University of Wisconsin—Milwaukee, Milwaukee, Wisconsin, USA, [7]Anthropology, University of the Free State, Bloemfontein, South Africa, [8]The Genome Institute, Washington University, St. Louis, Missouri, USA, [9]Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, United Kingdom

Introduction

Eco-Evo and One Health philosophies have heightened interest in transmission of antibiotic resistant pathogens between humans and animals. We investigated the carriage of common human pathogens amongst human-habituated wild monkeys (*Chlorocebus sabaeus*) in The Gambia.

Methods

In 2011, we collected 64 nasopharyngeal and 63 oropharyngeal swab samples from 64 Gambian wild monkeys. Conventional microbiology was used to identify bacterial species, and antimicrobial resistance determined for all *Staphylococcus aureus* isolates by the disc diffusion method.

Results

Four human pathogens were identified overall: Viridans streptococci (111/127, 87%); *Staphylococcus aureus* (83/127, 65%), Coagulase-negative Staphylococci (50/127, 39%), and *Pseudomonas aeruginosa* (5/127, 4%). 25/127 (20%) samples grew *Bacillus* species (not anthracis). Six morphologically distinct organisms

could not be speciated: four gram-negative bacilli, one gram-negative cocci, and one gram-positive cocci in clusters. Co-colonisation was high—all subjects carried more than one pathogen (up to 6 different organisms) in both naso- and oropharyngeal mucosae, with exception of one subject which was colonised in its nasopharynx with Viridans streptococci only. Of the *S. aureus* isolates, 1/83 (1%) was resistant to gentamicin; 1/83 (1%) intermediately resistant to chloramphenicol and tetracycline; 2/83 (2%) resistant to penicillin; 1/83 (1%) resistant to ceftriaxone and erythromycin; and 15/83 (18%) intermediately resistant to erythromycin. No multi-drug-resistant isolates were found.

Conclusions:

Human-habituated wild monkeys in the Gambia harbour pathogens of human importance, including organisms with known intrinsic resistance, such as *Pseudomonas aeruginosa*. Careful surveillance is needed in order to unearth reservoirs for the emergence of drug-resistant pathogens of zoonotic potential.

Investigating Ancient Hominin *ABO* Haplotype Structure From Modern Populations

KEOLU FOX[1], IAN B. STANAWAY[2], JILL JOHNSEN[4] and DEBORAH A. NICKERSON[3]

[1]Medicine, University of California, San Diego, [2]Biomedical Informatics and Medical Education, University of Washington, [3]Department of Genome Sciences, University of Washington, [4]Blood Works Northwest, Seattle

Characterizing variation in the ABO gene is important in transfusion and transplantation medicine because variants in ABO have significant consequences with regard to recipient compatibility. While many believe that the genetics of the ABO locus is well understood, little is known about the impact of novel, rare variation in the ABO gene. Here, we analyze next-generation sequence derived coding variation in ~2,500 individuals from 28 populations, including two ancient hominins (Neanderthal and Denisovan). We hypothesize that imputed ABO types from the 1,000 Genomes Project will recapitulate previous estimates based on serologically derived ABO blood types (Cavalli-Sforza et al., 1994) and allow us to impute ABO haplotype structure in ancient hominins. Through our analysis, we validated previous estimates of ABO blood type based on serology. We identified common variants known to influence ABO function, including those known to the common A and B haplotype as well as a common deletion that leads to the O genotype. We also identified rare population specific coding variants within ABO including single nucleotide/missense variants and insertion/deletions. We then used those haplotypes to impute ABO blood type for both ancient hominins. These analyses are important for future studies of human blood group genes to (1) improve the specificity of blood typing at both the clinical and research level by identifying rare functional alleles that might result in atypical serological patterns, (2) illuminate ABO gene architecture on a global scale, and (3) assess the potential for introgression of ancient ABO haplotypes found in contemporary human populations.

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How similar are women's hormone profiles from one pregnancy to the next?

MOLLY FOX[1], CURT SANDMAN[2], ELYSIA DAVIS[3] and LAURA GLYNN[4]

[1]Department of Anthropology, UCLA, [2]Department of Psychiatry & Human Behavior, UC Irvine, [3]Department of Psychology, Denver University, [4]Department of Psychology, Chapman University

It is unknown how similar a woman's hormone levels during one pregnancy are to the same woman's hormone levels during a subsequent pregnancy. Circulating hormone concentrations during pregnancy are of major interest for understanding how reproductive life-history endocrinology affects health and development of both mother and child. Knowing whether women experience similar concentrations of hormones in each of their pregnancies can improve our estimation of lifetime (cumulative) exposures to the endocrine conditions of pregnancy. For understanding child development, many studies compare monozygotic twins, dizygotic twins, and sibling pairs to determine the contributions of genetics, intrauterine environment, and postnatal environment to phenotype. These comparisons assume highly variable intrauterine conditions in different pregnancies of the same mother, and yet the degree of similarity between siblings' prenatal environments remains unknown. Our study aimed to investigate how consistent women's hormone profiles are across two successive pregnancies. This longitudinal, prospective study followed a cohort of 28 women across two pregnancies, measuring at multiple timepoints women's circulating adrenocorticotropic hormone (ACTH), placental corticotropin-releasing hormone (pCRH), cortisol, estradiol, and progesterone. Results reveal substantial consistency from one pregnancy to another, and substantial predictability from one pregnancy to another. This is the first study to describe maternal and placental hormone levels across successive pregnancies.

Wild female chimpanzees are more social and feed less often when they have young infants

STEPHANIE A. FOX[1], ZARIN P. MACHANDA[2], MARTIN N. MULLER[1], EMILY OTALI[3], RICHARD W. WRANGHAM[4] and MELISSA EMERY THOMPSON[1]

[1]Anthropology, University of New Mexico, [2]Anthropology, Tufts University, [3]Kibale Chimpanzee Project, Fort Portal, Uganda, [4]Human Evolutionary Biology, Harvard University

Primate females face intense energetic demands during gestation and lactation. These demands are often met by increasing caloric intake, which can mean lengthening the active period, spending a greater proportion of time feeding, or focusing on higher-quality foods. Increased foraging effort is expected to compromise other activities, particularly social behavior.

We investigated how reproductive state influences activity in wild female chimpanzees (N=16) at Kanyawara in Kibale National Park, Uganda. Using focal follow data from 2009-2014, we compared feeding and social behaviour for females during pregnancy, the first two cost-intensive years of lactation ('early lactation'), and all other times ('late post-partum').

Day length did not vary with female reproductive status (Cox proportional hazard, robust logrank test N=876, p=0.41, $x^2(3)=2.86$). Females in early lactation spent a smaller proportion of time feeding than pregnant females (LMM: N=751, p=0.04, B=-18.18), but neither differed from late post-partum females. Females in early lactation spent a greater proportion of time socializing compared to pregnant and late post-partum females (LMM: N=751, p<0.01, B=1.10 and p=0.03, B=0.50 respectively).

Contrary to expectation, females in early lactation did not increase their active period and actually decreased the time budget for feeding. This could reflect constraints on efficient foraging, but we found that lactating females traded off feeding time with increased social time. These findings suggest that there are significant benefits to being social when raising young infants, but also that females must meet energetic needs in ways other than increased feeding time.

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Shifting Agriculture and Climate Change: Effects on Crowned Lemur and Sanford's Lemur Ecology in Northern Madagascar

BENJAMIN Z. FREED and NATHANAEL R. BARTOSCH

Anthropology, Sociology, and Social Work, Eastern Kentucky University

Primate species often use resource partitioning to share a habitat, yet significant changes in resource availability brought on by climate change may severely impact their ecology. We collected behavioral data on two crowned lemur groups (*Eulemur coronatus*) and one Sanford's lemur group (*Eulemur sanfordi*) in forest fragments they share with farmers. We compare the lemurs' dry season ecology in 2016 (normal

year, n=140 hours) and 2017 (drought year, n=240 hours). The most significant drought-related habitat change was when a local lemur-protecting farmer moved away. Crowned groups remained in similar locations, but five of 2016's six Sanford's groups shifted their home ranges away from the one farm. Both species consumed clumped arboreal resources, but when these were unavailable, all lemurs foraged extensively on fruit from the bush, *Lantana camara.* Drought impacts on groups included: 1) one crowned group slightly, but not significantly, expanded its reliance on *Lantana* by foraging, feeding, and traveling more than 48% of each day; 2) the other crowned group and the Sanford's group spent the first half of the 2017 study resting more than 77% per day, while presumably eating *Ceiba* nectar nocturnally; and 3) all three groups spent the second half of the 2017 study consuming *Ficus* and *Lantana*. The drought and shift in human ranges increased the lemurs' predator pressure, reduced the abundance of this habitat's large fruit trees, and promoted the spread of *Lantana* bushes. As in other primates, behavioral flexibility and resource partitioning may help these lemurs survive the change in climate.

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Biocultural drivers of bushmeat hunting in Southeast Nigeria: Implications for Nutrition and Infectious Disease Syndemics

SAGAN FRIANT[1,4], JERRY K. JACKA[3], CLEMENT B. I. ALAWA[5], DAVID A. OGAR[4], TONY L. GOLDBERG[2] and JESSICA M. ROTHMAN[1]

[1]Anthropology, Hunter College of the City University of New York, [2]Pathobiological Sciences, School of Veterinary Medicine, University of Wisconsin - Madison, [3]Anthropology, University of Colorado - Boulder, [4]Forestry and Wildlife Resources Management, University of Calabar, Nigeria, [5]Animal Health and Production, Faculty of Veterinary Medicine, University of Abuja, Nigeria

Bushmeat is an important resource for rural and highly marginalized forest communities across West and Central Africa, but hunting threatens biodiversity and bushmeat carries zoonotic disease risks. Paradoxically, bushmeat may also enhance health by improving nutrition, which, for example, may improve immunity. We used biocultural methods to describe bushmeat in local diets and to examine interactions between bushmeat consumption and human nutrition. Between May and September 2017, we conducted 24-hour dietary recalls and food insecurity assessments (n=478) in six Cross River National Park communities in Nigeria. From responses to dietary recalls, 32 different types of bushmeat were consumed. Overall, bushmeat was more culturally salient, organoleptically appealing, and more widely consumed (56%) compared to meat from domestic animals (16%). However, these patterns varied by bushmeat species, revealing underlying structure in meat preferences and perceptions of wild animals across cultural domains (e.g. hunting, food, medicine, etc.). Seventy-five percent of households were categorized as food insecure across multiple domains of food insecurity, with 65% reporting having anxiety about food, 87% reporting insufficient quality, and 87% reporting low intake and physical consequences. The probability of consuming bushmeat was higher in relatively food insecure households than in food secure households (OR= - 0.91 [0.88-0.95], p = < 0.001) and higher in enclave communities compared to forest edge communities (OR = 5.50 (3.13 – 9.95), p < 0.001). Our results emphasize the importance of biocultural-environment interactions in shaping bushmeat hunting and consumption practices, zoonotic disease risk, and associated impacts on conservation and public health.

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Size and Shape: Structural Correlates of the Human Ectotympanic Tube

ELLEN E. I. FRICANO[1] and VALERIE B. DELEON[2]

[1]Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [2]Department of Anthropology, University of Florida

Anthropologists and paleobiologists often use the ectotympanic tube as a large-scale phylogenetic indicator among primates. In such studies, the ectotympanic is described as present (ossified, as among catarrhines and tarsiers) or absent (cartilaginous). Factors influencing ectotympanic tube length and shape within and among species are poorly understood. This study used morphometric data to study the relationship of cranial shape and ectotympanic tube structure in adult humans. Specifically, we tested the hypothesis that the length and shape of the ectotympanic tube may be explained by lateral expansion of the primate brain relative to conserved aspects of the cranial base. Archaeological remains of 74 adult human crania were analyzed using 78 fixed and constructed landmarks capturing the shape of the cranium and ectotympanic tube. As the tube itself has few Type 1 landmarks, constructed landmarks were mathematically derived and dispersed along its length, thus capturing its shape. Landmark configurations were aligned using a partial Procrustes fit and compared using principal components analysis. Multivariate regressions were used to determine aspects of cranial shape correlated with relative ectotympanic length. The results show that the lengthening of the ectotympanic tube is significantly correlated with a widened cranial base and to a lesser degree a widened neurocranium. The relationships between ectotympanic length and cranial widths remain significant even when controlled for centroid size. These results are consistent with previous research and suggest that the ectotympanic tube is induced to lengthen by lateral displacement of the external acoustic meati associated with relative lateral expansion of the brain.

Femoral neck and shaft structure in *Homo naledi*

LUKÁŠ FRIEDL[1], ALEXANDER G. CLAXTON[2], CHRISTOPHER S. WALKER[3,4,5], STEVEN E. CHURCHILL[4,5], TRENTON W. HOLLIDAY[4,6], JOHN HAWKS[4,7], LEE R. BERGER[4], JEREMY M. DESILVA[4,8] and DAMIANO MARCHI[4,9]

[1]Department of Anthropology, University of West Bohemia, Plzen, Czech Rep., [2]Department of Anthropology, Boston University, Boston, USA, [3]Department of Molecular Biomedical Sciences, North Carolina State University, Raleigh, USA, [4]Evolutionary Studies Institute and Centre for Excellence in PalaeoSciences, University of the Witwatersrand, Johannesburg, South Africa, [5]Department of Evolutionary Anthropology, Duke University, Durham, USA, [6]Department of Anthropology, Tulane University, New Orleans, USA, [7]Department of Anthropology, University of Wisconsin, Madison, USA, [8]Department of Anthropology, Dartmouth College, Hanover, USA, [9]Department of Biology, University of Pisa, Pisa, Italy

The abundant femoral assemblage of *Homo naledi* provides a unique opportunity to test hypotheses regarding the taxonomy, locomotion, and loading patterns in this species. Here we describe neck and shaft cross-sectional structure of several *H. naledi* femoral specimens and compare them to a broad sample of fossil hominins, recent humans, and apes. Cross-sectional data from the femoral neck (base of neck and midneck) and diaphysis (midshaft and subtrochanteric) were taken from CT scans and data on comparative samples are either our own previously collected samples or data from the literature. Results show that *H. naledi* femoral neck midsection shape is superoinferiorly elongated and resembles early hominins, but only marginally overlaps with *H. sapiens* and apes. Cortical distribution around the superior and inferior margins is asymmetrical and falls within the range of *H. sapiens* (thin superiorly and thick inferiorly) to the exclusion of early South African hominins, but *H. naledi* is notable for having absolutely thicker cortex (higher %CA) than modern humans. *H. naledi* femoral shafts are gracile, falling below the range of majority of Pleistocene *Homo* specimens and overlapping with *Pan* and *Pongo*. *Homo naledi* midshaft diaphyseal shape is approximately round and resembles most other hominins and apes with the exception of Middle Pleistocene and Upper Paleolithic humans. However, *H. naledi* shows significantly higher relative AP rigidity at the subtrochanteric level than other hominins. As observed from previous analyses, *H. naledi* appears unquestionably *Homo* in

its femoral anatomy, but unique among hominins in its gracility and combination of characters.

Isotopic georeferencing for Miami sector undocumented border crossers

AMANDA N. FRIEND[1], GEORGE D. KAMENOV[2] and JOHN KRIGBAUM[1]

[1]Anthropology, University of Florida, [2]Geological Sciences, University of Florida

Every year, thousands of undocumented migrants undertake the dangerous maritime journey to enter the U.S. via Florida's shores. The Miami border sector, unlike others in the southern U.S., has historically apprehended individuals that were of non-Mexican origin. The number of deaths for the Coastal border sectors of the U.S. are not tracked, likely due to the difficulty of recovering remains from the water. That remains often cannot be directly attributed to border crossers due to lack of sufficient supporting evidence, including circumstantial evidence (e.g., possession of foreign currency, border crossing supplies, or other indicators of country of origin), further complicates the situation. This research aims to use isotopic analysis to infer country of origin for undocumented border crossers in Florida.

Biological anthropologists in other U.S. border sectors have applied isotopic analysis of skeletal tissue as an important line of evidence for georeferencing unidentified border crossers. However, these studies have focused on individuals from Mexico and Central America rather than those from the insular islands of the Caribbean (Greater Antilles).

Exploring spatial variation of biologically available strontium isotopes in the Caribbean, we explore the potential of determining country of origin for individuals who may have died while attempting to enter the U.S. without documentation. This study compiles archaeological, geological, and modern isotopic data to assess baseline heterogeneity between Caribbean islands. The results explore the degree of certainty and specificity of the isotopic analyses' ability to georeference modern individuals.

Review of Cercopithecidae from Upper Laetolil Beds, Tanzania, indicates presence of *Theropithecus*: biogeographic and taxonomic implications

STEPHEN R. FROST[1], CHRISTOPHER C. GILBERT[2,3,4,5] and ERIC DELSON[3,5,6,7,8]

[1]Department of Anthropology, University of Oregon, [2]Department of Anthropology, Hunter College of the City University of New York, [3]PhD Program in Anthropology, Graduate School and University Center of the City University of New York, [4]PhD Program in Biology, Graduate School and University Center of the City University of New York, [5]New York Consitium in Evolutionary Anthropology, [6]Department of Anthropology, Lehman College of the City University of New York, [7]Department of Vertebrate Paleontology, American Museum of Natural History, [8]Institut Català de Paleontologia Miquel Crusafont (ICP), Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain

Cercopithecid fossils from the Upper Laetolil Beds have a long and complex taxonomic history. Since the 1980s, four taxa have been recognized: *Parapapio ado*, a larger papionin, and two colobines – the larger tentatively attributed to either *Paracolobus* or *Rhinocolobus* and the smaller to *Cercopithecoides*. The absence of *Theropithecus,* (elsewhere hyperabundant) was initially attributed to the early age of the Upper Laetolil Beds, but recent identifications of *Theropithecus* at Kanapoi, Allia Bay, and Woranso-Mille make this explanation no longer tenable. Instead, its absence is thought to be related to biogeography or paleoecology. In 2013-2016 we reviewed Laetoli cercopithecids at the National Museum of Tanzania, the Natural History Museum, London and the Museum für Naturkunde, Berlin. Comparisons of the Laetoli material with fossils from throughout Africa largely confirmed previous observations, except several specimens previously recognized as *Pp. ado* were near perfect matches for *Theropithecus oswaldi* cf. *darti* from Woranso-Mille in mandibular and dental morphology, including the type of *Papio (Simopithecus) serengetensis*. Quantitative dental and discriminant function analyses confirmed these identifications. Due to highly primitive morphology, these earliest specimens of the *T. oswaldi* lineage are challenging to identify and may require recognition as a chronosubspecies older than *T. o. darti*. The presence of *Theropithecus* within the hypodigm of *Pp. ado* also necessitates revisiting comparisons of *Pp. ado* from Laetoli with possible occurrences elsewhere. Recognition of *Theropithecus* from the Upper Laetolil Beds makes the cercopithecid community more similar to other later Early Pliocene sites and demonstrates Laetoli was not so biogeographically distinct.

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Derived codon substitution in the Catechol-O-methyltransferase (COMT) gene may have implications for behavioral variation in hamadryas baboons (*P. hamadryas*)

AMANDA J. FUCHS[1] and JASON M. KAMILAR[1,2]

[1]Department of Anthropology, University of Massachusetts, [2]Graduate Program in Organismic & Evolutionary Biology, University of Massachusetts

There is evidence to suggest that increased aggression is derived in hamadryas baboons. Furthermore, a recent study isolated three genes (SLC6A3, COMT, and PPP1CC) associated with dopamine pathways in hamadryas (*P. hamadryas*) and anubis (*P. anubis*) baboons that may contribute to their divergent behaviors. The Catechol-O-methyltransferase (COMT) gene is involved in catabolizing catecholamine neurotransmitters, including dopamine. These neurotransmitters are involved in regulating mood and can contribute to aggressive behavior. Thus, COMT is a likely candidate for influencing behavioral differences between hamadryas and anubis baboons. Here, we quantified variation in COMT in hamadryas and anubis baboons. Also, we investigated whether COMT is derived in hamadryas baboons by including a macaque species (*M. mulatta*) as an outgroup. We used MEGA to align and translate COMT mRNA samples into proteins. We performed polymorphic site analyses in DnaSP and we identified 12 SNPs. Ten SNPs were fixed differences between the macaque and baboon species, and two were fixed specifically in hamadryas baboons. The small number of variant sites in this coding region and low π of 0.0032 suggests this gene is conserved across taxa. Although, one of the hamadryas fixed SNPs results in a non-synonymous substitution from serine to glycine. Interestingly, this codon produces serine in humans and chimpanzees and serves as a post-translational modification site in humans. Therefore, this derived codon substitution in hamadryas may be one factor influencing the behavioral variation across these taxa. Further analysis of this gene could have implications for the evolution of human behavior.

The evolutionary ecology of breastmilk folate among Ariaal agro-pastoralists in Kenya

MASAKO FUJITA[1,2], NERLI PAREDES RUVALCABA[1,2] and MARY CORBITT[2,3]

[1]Anthropology, Michigan State University, [2]Biomarker Laboratory for Anthropological Reserach, Michigan State University, [3]Animal Science, Michigan State University

Objective: Folate in breastmilk has important implications for offspring health and survival given the essential role of this vitamin in DNA synthesis, epigenetic functions, and amino acid metabolism. Yet, little is understood about the variation of folate in breastmilk and transfer across the postpartum year and beyond. Published studies tend to be limited to milk during days/weeks postpartum, and none applied an evolutionary perspective of parental investment. **Methods**: A secondary analysis of the data and specimens from 200 breastfeeding mothers within 1.5 years postpartum in food-insecure northern Kenya was conducted. ELISA determined folate-binding protein (FOLR1) in cryogenically archived breastmilk and maternal blood specimens, originally collected in 2006. Maternal folate was defined as blood serum

FOLR1 multiplied by −1 because elevated FOLR1 is associated with folate deficiency. The concentration of milk FOLR1 was evaluated in relation to maternal folate and 1) infant sex (Trivers-Willard hypothesis), 2) time postpartum and parity (maternal residual reproductive value) using regression models adjusted for covariates. **Results** indicated: 1) no Trivers-Willard effect; 2) support for time postpartum but not for parity. Maternal folate and time postpartum inversely predicted milk FOLR1. There was an interaction between these variables ($p<0.05$). Maternal folate improved over time at a varying rate while milk FOLR1 decreased at a relatively steady rate. This inverse relationship became stronger as time advanced. **Conclusion**: The priority shift from the investment in current offspring toward maternal soma and potential future offspring in this study provides empirical support for the evolutionary hypothesis of parental investment and parent-offspring conflict.

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Depression in African Americans: Using genetic and social network data to investigate variation in symptoms of depression

KIA C. FULLER[1,2,3], CHRISTOPHER MCCARTY[3,4], CLARENCE C. GRAVLEE[2,3] and CONNIE J. MULLIGAN[2,3]

[1]Genetics and Genomics Graduate Program, University of Florida, [2]Genetics Institute, University of Florida, [3]Department of Anthropology, University of Florida, [4]Bureau of Economic and Business Research, University of Florida

Depression is a prevalent mental illness in the US that affects certain racial groups disproportionately. African Americans tend to report more severe symptoms of depression than their European American counterparts and are also less likely to seek treatment for their disorder. This study employs a biocultural approach that integrates genetic and social network data to investigate variation in symptoms of depression in African Americans living in Tallahassee, Florida. Genetic and social network data and CESD scores (a validated questionnaire that measures symptoms of depression) were collected from 138 participants.

Single nucleotide polymorphisms were assayed in the following candidate genes that previous studies found to be associated with depression: *HTR1A, HTR2A, BDNF, SLC6A4, 5-HTTLPRI, GNB3, TPH1,* and *FKBP5*. In a previous study on blood pressure, we found that incorporating both genetic and social network data provided a statistically significant optimal model that accounted for more variation in blood pressure than models including only one type of data. We take a similar approach in this study, where we find that certain network composition measures, e.g. the percent of alters (network members) that the participant found stressful, were positively associated with CESD scores (p-value = 0.002). Measures of sleep quantity (p-value= 0.002) and money strain (p-value =0.039) were also positively associated with symptoms of depression. Years of education and measures of employment were negatively correlated with symptoms of depression (p-value =0.05, and p-value = 0.003, respectively). Our study highlights the importance of investigating genetics and social networks when studying complex mental illnesses.

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Is Lemuriformes an adaptive radiation?

ETHAN L. FULWOOD

Evolutionary Anthropology, Duke University

Lemuriforms constitute some 16% of global primate diversity and appear to represent a classic "adaptive radiation" into a wide range of niches. Adaptive radiations typically show 1) greater than expected ecomorphological disparity, 2) causally associated with taxonomic diversification, 3) facilitated by the exploitation of newly available ecological opportunities. The extent to which lemuriforms meet these criteria has not been explicitly tested. Here, second lower molar length and the dental topography metrics Orientation Patch Count and Dirichlet Normal Energy from 21 genera are paired with disparity calculations and macroevolutionary modeling to evaluate this proposition with respect to dietary ecology.

Three approaches are taken. First, ecomorphological empirical disparity is calculated using Euclidean distances and compared to the distribution of expected disparities from a bootstrapped sample of primate taxa. Second, the morphological disparity index (MDI) is calculated to quantify the accumulation of disparity across a lemuriform tree and compared to a Brownian motion expectation. Finally, quantitative state speciation and extinction (QuaSSE) models incorporating interaction between origination rates and ecomorphology are compared to simpler models using AIC. Empirical disparity and the pattern of disparity accumulation are not significantly different from the null expectation. Diversification appears to be associated with ecomorphology, with a positive "drift" term, indicating an increase in the values of the metrics across the tree. Together, results do support a role for increased exploitation of defended plant resources, such as leaves, in the diversification of lemurs, but are inconsistent with an explosive "early burst" of morphological evolution into newly open ecospace.

Earliest hominid evidence of caries lesion and dental calculus from the Middle Miocene (12.5 Ma) – implications for dryopithecin diet and metabolism

JOCHEN FUSS[1,2], GREGOR UHLIG[3] and MADELAINE BÖHME[1,2]

[1]Department of Geoscience, Eberhard-Karls-University Tuebingen, Germany, [2]Senckenberg Centre for Human Evolution and Palaeoenvironment (HEP), Tuebingen, Germany, [3]Department of Chemistry and Food Chemistry, Technical University Dresden, Germany

The formation of dental caries is mainly caused by dietary habits and therefore, may contain information for dietary reconstructions of fossil hominids. This study investigates the caries lesion in the 12.5 Ma old type specimen of *Dryopithecus carinthiacus* Mottl 1957 (Primates, Hominidae) from Austria, using micro Computer tomography (µCT) and scanning electron microscopy (SEM). Potential food sources are identified on associated palynological data. *D. carinthiacus* documents the earliest record of dental caries and calculus in a hominid and further, provides information about the dietary habits of this individual. Its advanced primary caries indicates a frequent intake of sugar rich food. This finding corresponds with the palynological record, which infers a habitat with nearly year-round supply of carbohydrates. Our data provide new evidences for dietary reconstructions and infer implications for the metabolism of Middle Miocene dryopithecines.

Stress and frailty in Medieval Prussia: Interpretations from skeletal remains at Bezławki

KATHERINE GADDIS[1], ARIEL GRUENTHAL-RANKIN[1,2], MARISSA RAMSIER[1], ARKADIUSZ KOPERKIEWICZ[3] and MAREK POLCYN[4]

[1]Anthropology, Humboldt State University, [2]Anthropology, Binghamton University (SUNY), [3]Archaeology, University of Gdansk, [4]Anthropology, Lakehead University

Health is routinely studied in living populations using quantifiable measurements such as allostatic load and frailty. In recent years, particularly since the introduction of the osteological paradox, there has been increased interest among bioarchaeologists in how these concepts can be applied to the study of health in past populations. Although health is not directly observable in skeletal remains, assessment of frailty can be useful for understanding the implications of long-term exposures to stress on well-being and mortality. This study builds upon past research in this area by incorporating commonly observed indicators of physiological stress, such as dental disease and osteoarthritis, into a cumulative index that can be used to assess frailty in archaeological populations. A sample of 40 individuals (males, n=16; females, n=17; undet., n=7) between the

ages of approximately 7.5 and 65 years from the Late Medieval site of Bezławki in north-eastern Poland, were examined for evidence of 13 biomarkers of physiological stress related to nutritional deficiencies, growth disruption, infection, and trauma. These categories were chosen based on their potential to affect the lifestyles of individuals in the past and present. Following examination, each individual was assigned a frailty score, which was then compared across groups within the population. Preliminary results indicate variation in frailty levels among age and sex cohorts, suggesting this is a promising method for assessing frailty in skeletal remains. Ongoing research will explore the relationship between frailty and lifestyle in Medieval Prussia, an area which currently has sparse historical records.

Phylogenetic history of the primate AMY gene family

CHRISTIAN M. GAGNON[1] and MICHAEL E. STEIPER[1,2,3,4]

[1]Anthropology, Hunter College of the City University of New York (CUNY), [2]Anthropology, The Graduate Center of CUNY, [3]Human Biology Program, Hunter College of the City University of New York (CUNY), [4]NYCEP, New York Consortium in Evolutionary Primatology (NYCEP)

Interest in the relative importance of dietary starch versus meat-derived proteins in human evolution has led to numerous inquiries into human dietary adaptations. One such adaptation to starch digestion is found in the amylase gene family, where presence of copy number variation at the AMY gene is linked to variation in the intake of dietary starch (Perry et al., 2007 Nature Genetics). Like humans, non-human primates have varying levels of starch intake and amylase expression, yet little is known about the evolution of the amylase gene family in primates. Here we investigated genomic data from 11 primate species to determine the copy number and history of gene duplications of the amylase gene family. Our findings show that the ancestral catarrhine likely had a single amylase gene. This gene family duplicated to 3 copies in apes and independently duplicated to 2 copies in Old World monkeys. Humans are the only primate species with an expanded AMY1 gene cluster. Gorillas may have duplicated their AMY2 genes. We infer that any variation in the expression of AMY in non-human primates likely is not mediated via copy number variation and therefore must be regulated by other means. More research in this area is needed to probe the connections between diet and genomic adaptations in primates.

Dental macrowear in catarrhine primates: variability across species

JORDI GALBANY[1], JEAN CLAUDE TWAHIRWA[2], LAURA BAIGES-SOTOS[3], ERIN E. KANE[4], DEOGRATIAS TUYISINGIZE[2], PRINCE KALEME[5], AGGREY RWETSIBA[6], ROBERT BITARIHO[7], MICHAEL R. CRANFIELD[8], TIMOTHY G. BROMAGE[9], ANTOINE MUDAKIKWA[10], TARA S. STOINSKI[2], MARTHA M. ROBBINS[11] and SHANNON C. MCFARLIN[1]

[1]Center for the Advanced Study of Human Paleobiology, The George Washington University, Washington DC, USA, [2]., Dian Fossey Gorilla Fund International, Atlanta, USA, [3]Department of Archaeology, The University of Sheffield, UK, [4]Department of Anthropology, Boston University, USA, [5]., Centre de Recherches en Sciences Naturelles, Lwiro, Bukavu, Democratic Republic of Congo, [6]., Uganda Wildlife Authority, Kampala, Uganda, [7]Institute of Tropical Forest Conservation, Mbarara University of Science and Technology, Kabale, Uganda, [8]Mountain Gorilla Veterinary Project, University of California at Davis, USA, [9]Hard Tissue Research Unit, New York University College of Dentistry, USA, [10]Department of Tourism and Conservation, Rwanda Development Board, Kigali, Rwanda, [11]., Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

Tooth macrowear is caused by a cumulative loss of enamel and dentine, principally due to the action of opposing teeth (attrition) and the friction of hard and abrasive food objects (abrasion) reflecting the interaction between feeding behavior and a species' environment. Tooth wear is also functionally significant because it is related to fitness components in several animal species. However, comparative data that would allow delineating the contribution of each of these factors are lacking. Here, we study molar tooth wear by calculating percent of dentine exposure (PDE) from standard photographs in 20 catarrhine primate species (N~700 wild specimens) from different habitats and diets. Occlusal dental images were obtained from several osteologic collections and tooth molds collected from living wild primates. To compare these species, we calculated a tooth wear rate between molars (M3 versus M1) using linear regression analyses, all of which were significant ($p<0.05$). Results show a great variability between species. For example, mangabeys (*Cercocebus torquatus* and *C. agilis*) and golden monkeys (*Cercopithecus kandti*) show high tooth wear rates, while red-tail monkeys (*Cercopithecus ascanius*) and eastern gorillas (*Gorilla beringei graueri* and Virunga *G. b. beringei*) show the lowest tooth wear rates. Species differences in tooth wear rate can be explained by general diet categories and by enamel thickness. Those primates who consume harder foods present higher tooth wear rates than folivorous and frugivorous species, while primates who present thicker enamel present lower tooth wear rates.

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Night in the light of day: what vocal communication of diurnal and cathemeral lemurs can tell us about the calls of nocturnal Strepsirrhines

MARCO GAMBA, DARIA VALENTE, VALERIA TORTI, LONGONDRAZA MIARETSOA, BAKRI NADHUROU, ALESSIO ANANIA, OLIVIER FRIARD and CRISTINA GIACOMA

Life Sciences and Systems Biology, University of Torino - ITALY

Long-distance signals of animals differ in their acoustic structure from calls used to communicate at short range because they evolved to maximize transmission in a particular habitat. Lemurs show different patterns of activity that allowed describing them as diurnal, cathemeral, and nocturnal. Most taxa are conspicuously vocal, but the utterances can dramatically vary across different species.

To investigate this variation in relation to effective distance and activity cycle, we analyzed the acoustic features of 48024 vocalizations emitted by members of nine species (*Eulemur* coronatus, *E.* flavifrons, *E.* fulvus, *E. macaco*, *E.* mongoz, *E.* rubriventer, *Varecia* variegata, *Indri indri*, *Propithecus* diadema), recorded in both their natural habitats and captivity. We measured the spectral demarcation values for quartiles (25%, 50%, and 75%) below which energy is concentrated in the different vocalizations. We ran General Linear Mixed Models using the frequency of the energy quartiles as the response variable, effective distance, activity cycle, and body mass as fixed factors and species ID as the random factor.

We found that long distance calls showed higher spectral values than short range calls ($P<0.001$). The quartiles of the calls emitted by cathemeral species were higher than those measured in diurnal species' calls ($P<0.001$). Thus, the evidence supported the idea that factors related with maximizing long-distance transmission through the environment may have played a critical role in the evolution of lemur communication. The higher spectral values of cathemeral species are in line with evidence that nocturnal species use higher pitched calls when communicating at a long distance.

Explaining variations in pterion articulation patterns

NAMBI J. GAMET and JOAN C. STEVENSON

Anthropology, Western Washington University

Pterion is a clinically important landmark positioned posterior to the eye orbits where four cranial bones (sphenoid, parietal, temporal and frontal) articulate in 4 patterns: spheno-parietal (SP), fronto-temporal (FT), stellate and epipteric. Mammal species express 100% SP or 100% FT. Ashley Montagu noted patterns varied within primate species including humans.

Variability in pattern expression is rare and implies a reduction in canalization. Species from the Burke Museum (UW) were examined: 30 each of *Canis latrans, Vulpes vulpes, Ursus americanus* and *Puma concolor*, 8 each of *Papio hamadryas* and *Saimiri sciureus* and 21 *Lepus americanus*. Species grouped into FT and SP were significantly different for average suture length (SL); thus, SL is proxy for FT and SP. Size and shape are hypothesized to be important to variation in pattern expression. Factor analyses of measures on of vertebrate skulls illuminated differences among vertebrate species grouped by FT vs SP and for levels of cranial index (CI) (all dolichocephalic with 3 modes- 5 total groups because no FT with high CI).

Only one principal component (PC) was extracted for SP species with low CI scores (variance explained: 80%), SP medium (92%) and FT medium CI (90%). Three PCs were extracted for small FT (3 PC explained 100%) and large SP (3 PC 88.5%). Measures are highly intercorrelated but size and shape (CI) are important in first PC of each group. The results of this analysis indicate that changes in cranial growth and size impact the articulation patterns at pterion.

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The immunomodulatory role of cortisol on proinflammatory leukocyte subsets among Honduran immigrant women on Utila

ANGELA R. GARCIA[1,3], MICHAEL D. GURVEN[1], SERGIO MURILLO[2,3], MARIELA MARQUEZ[3] and AARON D. BLACKWELL[1]

[1]Anthropology, University of California Santa Barbara, [2]Escuela de medicina, Universidad Tecnologica de Honduras, San Pedro Sula, Honduras, [3]Centro de Salud, CESAMO, Utila, Honduras

Psychosocial stress is consistently linked to poor health and wellbeing, yet the pathways through which stress affects health are often disputed. The consistent association of the hypothalamic-pituitary-adrenal (HPA) axis and one of it's primary hormones, cortisol, with inflammation has been proposed as a way in which psychosocial stress contributes to health issues. While inflammation tends to be treated as acute or chronic, we propose that a neglected factor may be the diurnal regulation of inflammatory immune function. Numerous inflammatory cytokines are regulated by the circadian rhythm of the HPA axis, and follow an inverse diurnal profile to cortisol. Though literature links the diurnal cycle of cortisol to diurnal patterns of immunity, existing literature neglects to examine the importance of this diurnal cycle of immunity in ecological context, where there is variance in baseline levels of both cortisol and inflammation. The Honduran island of Utila lacks basic infrastructure for sanitation in many areas, leading to heightened exposure to pathogens compared to most U.S. contexts. In previous work we established a relationship between perceived socioeconomic status and cortisol. Here, we extend this work to examine the relationship between diurnal cortisol and the diurnal rhythmicity of granulocytes, as a marker of innate cell-mediated immunity, among Honduran women (n=119) on Utila. We find that blunted cortisol is significantly associated with blunting in diurnal change of granulocytes as a proportion of total leukocytes (p=0.002), suggesting that alterations to diurnal cortisol can disrupt the diurnal rhythmicity of leukocyte expression, which may contribute to variation in health.

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Selection mapping to identify Flavivirus response loci in the Americas

OBED A. GARCIA[1], KENDALL ARSALANIAN[2], DANIEL WHORF[3], MARK SHRIVER[4], LORNA G. MOORE[5], TOM BRUTSAERT[6] and ABIGAIL W. BIGHAM[1]

[1]Anthropology, University of Michigan, [2]Anthropology, Yale University, [3]Feinberg School of Medicine, Northwestern University, [4]Anthropology, Penn State University, [5]Obstetrics and Gynecology, University of Colorado, [6]Exercise Science, Syracuse University

Flavivirus is a family of viruses that includes Dengue, Zika, West Nile, and Yellow Fever. Its rates of infection in Latin America are growing at the fastest rate globally, however Flavivirus has not persisted for a sufficient number of generations in the Americas to have specific signatures of selection. Infectious diseases demonstrate some of the strongest signatures of selection in the genome because they manifest themselves physiologically thereby improving chances for survival and reproduction. This makes signatures of selection an attractive strategy to identify susceptibility alleles for infectious disease as opposed to solely using a candidate gene approach. Our analysis focuses on a blind selection scan using the following statistics: the locus specific branch length (LSBL) and the cross-population haplotype test (XP-EHH) for hard selective sweeps. A population of indigenous Americans, including 25 Maya and 14 Mesoamericans from Mexico, were assayed on 906,600 SNPs (Affymetrix 6.0 array). Hapmap data from 90 East Asians from China and Japan and 60 Utahans of northern European ancestry were used. Analyses were limited to a 1% cutoff of the empirical distribution. 341 windows (200kb) were significant at the 1% level for both statistics. Strong signatures were demonstrated in genes belonging to the NF-kB pathway, including *GZMB*, *PSMB8*, and the MHC Class II complex. This pathway is important to Flavivirus disease progression and potentially behaves differently in Dengue-infected people. Although Flavivirus is not responsible for signatures of selection, the data from the signatures should be used to select candidate loci based on functionally different alleles.

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Broken bones and forgotten people: Insight into the lives of america's socially disadvantaged as seen in the terry and huntington collections at the turn of the 20th century (1898-1925)

SYDNEY S. GARCIA[1], DAVID HUNT[2] and MITCHELL RAUH[3]

[1]Department of Anthropology, San Diego State University, [2]Department of Anthropology, Smithsonian Institution, [3]School of Exercise and Nutritional Sciences, San Diego State University

Part of a larger analysis focusing on lower limb fractures and enthesopathies, this research assesses differences in tibial/fibular trauma with relation to demographic frequencies between the New York City Huntington Collection and St. Louis Terry Collection to elucidate hardships populations endured during the turn of the 20th century. The Huntington and Terry provide insight into the lives of marginalized lower socioeconomic status communities, and trauma is a reliable way to understand class disparities. State of healing and whether a fracture has been set properly can reflect healthcare resources and economic privileges. Comparing 277 individuals using chi-square analysis, would there be significant differences between the populations due to similar treatment of the lower class. Majority demographics were: male (76.2%), white (56.3%) and between the ages of 36-54 years (43%). From the larger sample, 18.8% (n=52) had tibial/fibular fractures with 9% in the Terry and 9.7% in the Huntington. The results of this study determine that in the tibia and fibula, there were no significant sample differences between sexes (p=.69); however, there are trending differences in likelihood of fracture occurrences (p=.02). There were no significant relationships between fractures and racial groups (p=.09) or regions (p=.41). This is an unexpected outcome for it would be anticipated that trauma would be more frequent in White immigrant populations and individuals in larger urban New York City who would have suffered from different activities than populations in smaller St. Louis. Fracture evidence suggested that lower-class populations were subjected to similar treatment despite locality, sex, or ancestry.

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Scurvy and cribra orbitalia: A new approach to differentiate orbital roof lesions from an analysis of Medieval Fishergate House, York, UK

BRIANNA N. GARDNER and TINA JAKOB

Department of Archaeology, Durham University

Nutritional deficiency diseases, such as scurvy and anemia, produce similar lesions, with scurvy commonly mistaken as cribra orbitalia. Sixty non-adult and adult individuals from Medieval Fishergate House, York were studied to reassess existing methods used in diagnosing orbital roof lesions. A new method of lesion recording was developed to determine the accuracy of past diagnoses. Diagnoses other than scurvy and anemia were considered during the reclassification of lesion types. As past studies diagnosed orbital roof porosity as cribra orbitalia without providing pathology descriptions for differential diagnosis, this new reclassification of the lesion identification system is vital for future research. The new lesion type classifications allow more inclusive descriptions and expanded potential diagnoses of orbital roof lesions. Differential diagnoses include: scurvy, pellagra, vitamin D deficiency, nonspecific infection, normal growth, postmortem damage, and disease comorbidity. Results from the study suggest the new recording method and classification system remedied past errors in lesion diagnosis for Fishergate House, York, as anemia had previously been over-reported in the population. Additionally, several individuals presented possible cases of scurvy, not previously noted, and these should be further analyzed. The reclassification of orbital roof lesions and the implementation of thorough and consistent recording produced more reliable differential diagnoses. This study demonstrates the importance of and encourages further unbiased re-evaluation of existing techniques used in paleopathological research. We suggest that since the new classification developed in this study might rectify past recording errors, the method should be considered as a standard in identification of orbital lesions in future research.

Social Identity and Disability in Prehistoric Central California: evidence for community support, accommodation, and care at the Yukisma Mound (CA-SCL-38)

KAREN S. GARDNER[1], ERIC J. BARTELINK[2], ANTOINETTE MARTINEZ[2], ALAN LEVENTHAL[3] and ROSEMARY CAMBRA[4]

[1]Cultural Resources Management, GEI Consultants, Inc., [2]Anthropology, California State University, Chico, [3]Anthropology, San Jose State University, [4]Chairwoman, Muwekma Ohlone Tribe of the San Francisco Bay Area

The Bioarchaeology of Care methodology provides a useful structure for interpretation of individual life histories in the past, based on osteological and contextual observations. Broadening the scope of analysis to a community level has the potential to yield valuable insights about social dynamics of past communities, including inclusive or exclusive social policies, adaptation to adversity, accommodation of difference, and the role of disability in defining social identity.

The present study applies the Bioarchaeology of Care to the ancestral Ohlone community of Santa Clara Valley, California, interred in the Yukisma Mound (CA-SCL-38) between ~940 and ~230 BP. Excavations during the early 1990s recovered the remains of 248 individuals. Osteological analysis prior to repatriation revealed evidence that 27 of these individuals (11%) lived with a condition which would have prevented them from participating in subsistence activities in the same way as other people. Of these, eight had congenital or developmental conditions, eleven had healed traumatic injuries with evidence of compromised mobility, seven suffered from chronic illness, and one had evidence of neurological impairment.

Analysis of stable carbon and nitrogen isotopes from bone collagen (n=201), found no significant difference between the diet of individuals with disabilities and other adults in the community. Review of burial-associated artifacts found no significant difference in indicators of social status, and revealed some intriguing technological accommodations. Burial location within the organized cemetery showed no segregation based on disability. Collectively, this evidence suggests a community-level culture of caretaking, integration, and accommodation, as well as individual agency and resilience.

Mobility and body size at Neolithic Çatalhöyük: temporal patterns of a large-scale farming community in Turkey

EVAN M. GAROFALO[1], CHRISTOPHER B. RUFF[2] and CLARK S. LARSEN[3]

[1]Department of Basic Medical Sciences, University of Arizona College of Medicine - Phoenix, [2]Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [3]Department of Anthropology, The Ohio State University

Over ca. 1100 years of occupation (7100-5950 cal BC), the Neolithic settlement of Çatalhöyük (Turkey) underwent shifts in population density, occupation, and agrarian practices. These changes carry implications for community behavior and mobility. Population density reached a peak in the middle period of occupation and declined in the late occupation period. Agricultural, herding, and resource acquisition practices shifted, suggesting increasing mobility over time.

This study evaluates temporal patterns of adult body size (n=126) and bone strength (n=80). Stature and body mass were derived from femoral length and femoral head dimensions. A ratio of AP and ML cross-sectional bending strength (Z_x/Z_y) and Polar Section Modulus (Z_p) were calculated at femoral midshaft (reconstructed using bi-planar radiography and periosteal molds) and standardized for body size as a measure of mobility.

Results of Kruskal-Wallis comparisons indicate there is no temporal effect on stature or body mass among the early (n=7), middle (n=83), and late (n=24) periods. However, late period burial exhibit higher Z_xZ_y values (increased AP bending strength: $\bar{x}$ =1.07), while early and middle periods show relatively more ML bending strength in Z_xZ_y ratios ($\bar{x}$ =0.89 and 0.99). Differences reach significance between early and late period females (p<0.03).

Analyses support the assumption that individuals likely traveled greater distances in middle and later periods of occupation at Çatalhöyük, coinciding with environmental and archaeological evidence at the site. This analysis enhances the emerging picture of lifestyle and behavioral change at Çatalhöyük and broadens the context of cultural, temporal, and subsistence change in early farmers.

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Behavioral responses to the introduction of immature members to a previously established bachelor group of western lowland gorillas (*Gorilla gorilla gorilla)*

KYLEN N. GARTLAND[1], MONICA MCDONALD[2,3], STEPHANIE BRACCINI SLADE[5], CRICKETTE SANZ[2,4] and FRANCIS WHITE[1]

[1]Anthropology, University of Oregon, [2]Anthropology, Washington University in St. Louis, [3]AZA Reproductive Management Center, Saint Louis Zoo, [4]Congo Program, Wildlife Conservation Society, [5]Birmingham Zoo, Birmingham Zoo

In order to maximize social opportunities, western lowland gorillas (*Gorilla gorilla gorilla*) in zoos are housed in family or bachelor groups. While wild bachelor groups are transient, all-male groups in zoos may be maintained for many years. These groups should be carefully monitored, as keeping multiple males of different ages classes together, particularly during transitional periods, can result in escalating social tension. In this study, we examined how the bachelor group at the Saint Louis Zoo responded to the introduction of two immature males in 2011. Behavioral data were collected on all group members using 15-minute focal observations with 30-second instantaneous scans, totaling 185.25 hours with equal effort in baseline and transition conditions. A two-way ANOVA was used to determine differences in aggressive and affiliative behavior between individuals and the before and after conditions. There were no significant differences in aggressive behavior either between individuals or between conditions. However, we found significant

differences both between individuals (F=8.88, n=30, P<0.01) and between conditions (F-32.76, n=30, P<0.001) for affiliation as well as a significant interaction term (F=13.32, n=30, P<0.01). All individuals displayed an increase in affiliation following the introduction. Overall, we conclude that bachelor groups can endure destabilizing social transitions and remain cohesive social units. Behavioral changes will result from these transitions, but the extent to which they affect certain individuals and the group as a whole may vary. Therefore, longitudinal monitoring of bachelor groups can add to our understanding of the effects of demographic transitions on social behavior.

The "Buffalo Soldiers" of Fort Craig, New Mexico: Biomechanical Properties of the Femora and Humeri

SHELBY L. GARZA and DANIEL J. WESCOTT

Forensic Anthropology Center at Texas State, Department of Anthropology, Texas State University

Fort Craig, New Mexico, occupied between 1854 and 1885, was home to three black enlisted army units. Many of the enlisted black soldiers were assigned heavy labor duty in addition to combat duty. The purpose of this research is to examine long bone biomechanical differences between 11 black soldiers from Fort Craig and 32 contemporaneous black males from the Terry Collection. Bending and torsional rigidity at the midshaft and subtrochanteric regions of the femora and 35 percent of the distal end of the humeri were examined. Biomechanical properties were standardized for body size using head diameter and bone length. F-tests were run for each measurement to test for equal variances between the samples and appropriate t-test were used to compare groups. The results demonstrate that soldiers have a smaller body size than non-soldiers but greater values in minimum bending rigidity (Imin) of the femora at both midshaft and subtrochanteric and greater torsional rigidity (J) at femoral midshaft. The biomechanical properties of the humeri are larger for soldiers but not significantly. The soldiers also had greater circularity in cross-sectional shape (Imax/Imin values near 1). These results suggest that black soldiers from Fort Craig had a higher activity level and different patterns of loading than black males from the general public, and the lower limb long bone biomechanical properties reflect their demanding lifestyle.

The relative congruence of cranial regions and molecular data in hominoid phylogenetic reconstruction

JOANNA R. GAUTNEY

Department of Anthropology, University of North Carolina at Chapel Hill

Traditionally, phylogenetic analyses of hominin relationships use a range of craniodental characters. In these analyses, character choice is based on a number of criteria including interspecific variation, independence, and character polarity. Phylogenetic analysis in general and the cladistic methodology specifically have faced criticism by researchers in the past; much of the criticism has stemmed from the conflicting results many analyses produce, and the fact that morphological analyses have often failed to reproduce known molecular relationships among extant apes. Previous studies have examined the relative reliability of different cranial regions with varying results. This study addresses this issue by comparing the relative congruence of different cranial regions against consensus molecular genetic data for hominoid taxa. A data set of 198 craniodental characters was divided into six regions: masticatory characters, the vault, basicranium, face, temporal, and dentition. Phylogenies were built for each cranial region using the maximum parsimony function of the PAUP* software package for cladistic analysis, first including modern humans, then excluding modern humans. The most parsimonious trees produced for each region were then compared to the known molecular hominoid phylogeny. Results indicate that of the six regions, the basicranial and dental regions were the best able to reproduce known molecular relationships. Masticatory and facial characters showed little congruence with known molecular relationships. These results are consistent with the hypothesis that areas of the cranium that are under strict genetic control and resistant to plasticity are the most phylogenetically informative.

Xenarthran Pisiform Morphology and its Relation to Hominoid Locomotor Diversity

LIA M. GAVAZZI[1], KELSEY M. KJOSNESS[2] and PHILIP L. RENO[2]

[1]Department of Anthropology, The Pennsylvania State University, [2]Department of Bio-Medical Sciences, Philadelphia College of Osteopathic Medicine

The extant hominoid wrist joint is defined by ulnar withdrawal and distal relocation of the pisiform. This novel modification eliminates contact between the ulna and the pisiform typically observed in mammals, leaving the sole articulation of the pisiform with the triquetral. Furthermore, the pisiform has undergone a substantial reduction in *Homo* and *Pongo*, albeit by distinct developmental means. Humans have lost the pisiform primary center of ossification and growth plate, while these structures remain in the orangutan. The functional significance of these changes is difficult to ascertain. However, slow and cautious climbing lorisine primates have highly derived wrists with reduced pisiforms. The family Xenarthra, consisting of sloths, anteaters, and armadillos, exhibit a diversity of locomotor modes similar to primates. Sloths are obligate suspensors and giant anteaters engage in knuckle-walking. Several studies have noted similarities in xenarthran and hominoid wrist morphology, yet no study has focused on the medial wrist and pisiform. Here we compare these morphologies in hominoids, lorisines, and xenarthrans using uCT on a sample of lorisine and xenarthan adult and juvenile articulated wrists. We conduct a qualitative comparison with hominoids to better understand the adaptive significance of the hominoid medial wrist and diversity of developmental patterns underlying pisiform reduction. We observe numerous similarities with respect to in ulnar withdrawal and distal placement of the pisiform in xenarthrans and hominoids. Interestingly, the sloth pisiform is short similar to humans and orangutans, and the anteater pisiform is projecting and articulates with the triquetral like those of African apes.

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"Against Shameless and Systematic Calumny": Strategies of Domination and Resistance and their Impact on the Bodies of the Poor in 19th-century Ireland

JONNY GEBER[1] and BARRA O'DONNABHAIN[2]

[1]Department of Anatomy, University of Otago, [2]Department of Archaeology, University College Cork

Mid-Victorian British characterizations of Ireland and much of its population blamed race and "moral character" for the widespread poverty on the island. The Irish poor were portrayed as a "race apart" whose inherent failings were at least partly to blame for the mortality they suffered during the Great Famine of 1845–1852. Recent excavations at Kilkenny workhouse and Spike Island convict prison have produced skeletal assemblages from this critical period. These collections have enabled bioarchaeological analysis of parameters mentioned by the Victorians as indicative of the distinctiveness of the Irish poor: stature, interpersonal violence, and tobacco-use. Bioarchaeological data indicate that the differences between Irish and British populations in stature and risk of violence were exaggerated. Such characterizations, we argue, were part of a strategy of "othering" that served to legitimize colonial domination. This exertion of power did not go uncontested, as the pattern of tobacco-use may be indicative of forms of passive resistance.

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Variation in dentin structure in *Macaca fascicularis*, *Cebus apella* and *Lynx rufus*

ELISE GEISSLER

Anthropology, University of Florida

Dental structural integrity is a vital component of fitness and is thus likely under strong selection. While studies have shown that mammalian species differ in their dentin structure, dentin is rarely the focus of functional comparisons. Mammalian coronal dentin contains fluid-filled tubules which traverse tough intertubular dentin and are surrounded by hard cuffs of peritubular dentin. The amount of peritubular dentin has been shown to differ among some taxa.

Scanning electron microscopy images of transverse molar sections of durophagous *Cebus apella* and a carnivore known to develop high bite forces *(Lynx rufus*) were compared with those of a primate with a softer diet (*Macaca fascicularis*). The tubules and peritubular dentin were outlined by using ImageJ to measure the area of each and create ratios of peritubular dentin to tubule areas.

Nonparametric resampling tests showed no statistically significant difference in the ratios among the taxa. *Cebus apella* (n=2, tubule n=23), has the smallest average relative amount of peritubular dentin followed by *L. rufus* (n=4, tubule n= 84) and *M. fascicularis* (n=4, tubule n=67). Intraspecies comparisons of individual teeth produced smaller F-ratios for *M. fascicularis* (mean F=1.4) compared to *L. rufus* (mean F=2.5) and *C. apella* (mean F=2.01).

The results indicate that *C. apella* and *L. rufus* have less variation in their peritubular dentin ratios within each tooth compared to *M. fascicularis*. This finding is potentially explained as decreased selective pressure on dentin structure in *M. fascicularis*.

Dental Variation in Migrant Samples

REBECCA L. GEORGE and KYRA E. STULL

Department of Anthropology, University of Nevada, Reno

As migrant deaths increase at the United States-Mexico border, identification efforts continue to fall on forensic scientists. Dental variation within and among these migrants has only been provisionally explored. The current project aims to rectify this through a survey of dental morphological variation and cervical dental measurements. Individuals from the Pima County Office of the Medical Examiner (PCOME) in Tucson, Arizona (n=30) and from the Sacred Heart Burial Park in Falfurrias, Texas, currently housed at Texas State University (n=30), comprised the sample. Pearson's chi-square analyses found no significant differences in the dental morphological traits between the two geographic samples (p = 0.05, with a Bonferroni adjustment). T-tests were conducted on the cervical measurements and results found only one significant difference between the samples: lower P3 mesiodistal cervical measurement (p = 0.0078, with a Bonferroni adjustment). Given the lack of significant differences between the samples, cluster analyses were run utilizing subsets of all the data to explore the variation. The eight subsets were anterior and posterior dental morphology in each arcade and anterior and posterior cervical measurements in each arcade. The relevant number of clusters was always determined to be two and the cluster analyses accounted for 70.94-84.44% of the variation. Importantly, these clusters were not differentiated by sample, but they do indicate quantifiable differences exist between the dentition of the migrant samples under study. The differences may be attributable to regions-of-origin, though further research is necessary.

Trabecular bone structure of the distal femur in great apes

LEONI GEORGIOU[1], TRACY L. KIVELL[1,2], DIETER H. PAHR[3,4] and MATTHEW M. SKINNER[1,2]

[1]Skeletal Biology Research Centre, School of Anthropology and Conservation, University of Kent, Canterbury, United Kingdom, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany, [3]Institute for Lightweight Design and Structural Biomechanics, Vienna University of Technology, Wien, Austria, [4]Department of Anatomy and Biomechanics, Karl Landsteiner Private University of Health Sciences, Austria

The femur plays a critical and varied functional role during different locomotor modes of great apes and humans, and the morphology of knee joint in particular can provide key insights into the evolution of hominin bipedalism. Trabecular bone's ability to remodel in response to load makes it a potentially informative resource for investigating knee joint position, during extant and extinct ape locomotion. Here we implement a whole-epiphysis approach to analyze the structure throughout the distal femur in great apes and humans. Micro-computed tomography scans of *Homo sapiens* (n=11), *Pan troglodytes verus* (n=18), *Gorilla gorilla gorilla* (n=14) and *Pongo spp.* (n=7) were used to study trabecular patterns using medtool 4.1. Bone volume fraction (BV/TV) and degree of anisotropy (DA) were quantified within the whole epiphysis and statistical comparisons were restricted to six subregions of the condyles that were deemed the most informative and represent distinct areas of the condyles. Results reveal that BV/TV and DA distributions in the tibio-femoral articulation differ across great apes, but that humans are not as distinct as initially predicted. *Pan* shows higher BV/TV than *Homo* and *Gorilla* in the most posterosuperior portion of the condyles, *Homo* has higher DA than all other apes in the posterioinferior region and *Pongo* displays variable patterns of structural organization. These disparities in trabecular structure across taxa suggest loading in hyperflexed knee positions in *Pan*, more extended postures in *Homo* and less so in *Gorilla*, as well as varied joint positions in *Pongo*, and represent a comparative sample for extinct hominins.

Maternal Influences on Offspring Tool Use: Investigating Why Young Female Chimpanzees Are Faster Learners

KATIE F. GERSTNER[1], ROBERT C. O'MALLEY[2] and JULIE J. LESNIK[1]

[1]Anthropology, Wayne State University, [2]Dialogue on Science, Ethics, and Religon, American Association for the Advancement of Science.

Previous research on chimpanzees (*Pan troglodytes schweinfurthii*) at Gombe National Park, Tanzania have shown that female offspring are more proficient at termite fishing at an earlier age than male offspring, and that female tool techniques resemble their mothers. The aim of this study is to investigate if young female chimpanzees are learning how to termite fish faster than young males by sex-biased maternal behaviors. Here we test whether the nonverbal interactions rate between mother and offspring (< 10 yo) significantly differs by offspring sex. After analyzing 25 hours of video footage of termite fishing at this field site in 2009, mothers were found demonstrating a range of nonverbal actions with male offspring significantly more than they were with female offspring. Although interactions did not always direct offspring to a tool possession, these maternal actions would displace the offspring as they were actively watching, thus decreasing their learning opportunities. Results also confirm previous findings on female offspring behavior; females spent more intensive time spent watching their mothers rather than communicating signals to each other. Continued examination of these patterns of intended behavior would provide a better understanding about the variation in sex-biased maternal influence on offspring tool acquisition and learning opportunities in this chimpanzee population.

Reevaluation of the craniofacial morphology of *Theropithecus brumpti*: Implications for secondary sexual characteristics and reconstruction of its socio-sexual behavior

DAGMAWIT ABEBE GETAHUN[1,2,4], JAMES P. HIGHAM[3,4] and SCOTT A. WILLIAMS[3,4]

[1]Department of Anthropology, The Graduate Center, CUNY, [2]Department of Anthropology, Lehman College, CUNY, [3]Center for the Study of Human Origins, Department of Anthropology, New York University, [4]NYCEP, New York Consortium in Evolutionary Primatology

Sexual selection drives the evolution of mating systems and secondary sexual traits. Sexual dimorphism in canine and body size are

frequently used to reconstruct mating systems of fossil primates; however, these features are somewhat limited in their utility and the identification of other features correlated to variation in mating systems is desired. Males of two extant primates, orangutans and drills, possess facial flanges, which are associated with direct male competition and monopolization of females.

In the primate fossil record, one candidate for the possession of facial appendages is *Theropithecus brumpti*, a large papionin that lived in East Africa from about 3.6-2 Ma and possessed exceptionally large and flaring zygomatics. Several hypotheses have been proposed to explain this unique feature, all of which have been masticatory and related almost exclusively to diet. Here, we propose an alternate hypothesis to explain the presence of *T. brumpti*'s unique zygomatic morphology as a secondary sexual characteristic.

Cranial measurements previously associated with facial flanging in extant primates were evaluated in all species of *Theropithecus*. We predicted a significant difference in these measurements between flanged and unflanged species as well as between males and females of the flanged species. Results indicate significant differences in four previously-identified bony correlates of facial flanging between the hypothetical flanged and known unflanged *Theropithecus* species. Additionally, two of these measurements differ significantly between male and female *T. brumpti*. This supports the possibility that male *T. brumpti* possessed secondary sexual ornamentation and provides new insights into reconstructions of *T. brumpti*'s socio-sexual system.

Interpersonal conflict in the ancient South-Central Andes: contribution from human bone trauma patterns from Northwestern Argentina archaeological settlements (ca. 900-1450 AD)

MARIA SOLEDAD GHEGGI

Archaeology, Centro Regional de Investigaciones Científicas y Transferencia Tecnológica, Departamento de Humanidades, Universidad Nacional de La Rioja

The presence of a time of political fragmentation, social unrest and raising interpersonal conflict has been traditionally posited for the Andean area ca. 900-1450 AD. Although several causes were proposed, environmental degradation has been favored as an explanation. In this context, the analysis of 223 crania from different areas of Northwestern Argentina was carried out in order to test the hypothesis of the presence of endemic conflict. Results show that cranial trauma was found in 39 individuals including one subadult and in both sexes. No significant differences were found in trauma frequency among the sexes (X2=1.86; df=3;P=0,602), but women suffered more nasal trauma than men ((P= 0,044; Fisher's Exact Test). In general, the anterior sector of the cranium was the privileged location for trauma but the statistical evaluation of the differences did not showed a significant result (x2=8.04; df 4; p= 0.0901). Only two individuals showed perimortem trauma. When comparing trauma prevalence between settlements or regions, no significant results were found, suggesting that location or function of the sites may not have influenced in trauma frequencies. In this regard, the low lethality of fractures and prevalence of traumatic injuries seen for the entire sample (17%) coincide with the type of conflicts that may have arose in pre-Hispanic Andean societies, including raids, ambushes and assaults that were not intended to kill the adversary, considering the context of the environmental insecurity posited for the area.

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...From Inexpressible Loveliness to Practical Deception...: Structural Violence In Female Oriented Medical Practices

REBECCA GIBSON

Anthropology, University of New Hampshire

The medical profession of the late 19th and early 20th centuries had a fraught and complicated relationship with the female body. Newly defined as worth studying separately from the male body, women's problems were assumed to be related solely to their femaleness. Specifically, a medical problem that occurred in a woman that could not also occur in a man was treated as related to her uterus, directly or indirectly. Hysteria, or wandering womb syndrome, was used to explain all number of symptoms, and sexual excess, sexual frigidness, and lack of motherly feelings were all seen as diagnosable conditions to be cured physically. Enter one of the most recognizable symbols of femininity, the corset. A garment integral to femininity during this time, a corset is a multiple signifier—merely an undergarment, but also symbolic of a woman's ability to control her own social standing and physical form. This garment became pathologized by doctors, with the medical profession producing many documents describing the ruination which could be expected if women continued to wear the corset. This study looks at several of those documents, and shows how the doctors of the industrial time period used confusion over the workings of women's bodies, social anxiety about untamed sexuality, and the idea of the social responsibility to bear children, to enact structural violence upon women as a group, via bullying, berating, and shaming, which reduced a woman to her uterus and what she could produce from it.

Taxonomy of the fossil papionin genus *Parapapio* in the South African Plio-Pleistocene

CHRISTOPHER C. GILBERT[1,2,3], STEPHEN R. FROST[4] and ERIC DELSON[2,3,5,6,7]

[1]Department of Anthropology, Hunter College, CUNY, [2]PhD Program in Anthropology, The Graduate Center, CUNY, [3]New York Consortium in Evolutionary Primatology, (NYCEP), [4]Department of Anthropology, University of Oregon, [5]Department of Anthropology, Lehman College, CUNY, [6]Department of Vertebrate Paleontology, American Museum of Natural History, [7]Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona

The taxonomy of the Plio-Pleistocene papionin *Parapapio*, best known from South Africa, has long been debated. Three species are widely recognized to co-occur in South Africa, largely separated on the basis of molar size: *Pp. jonesi* (smallest), *Pp. broomi* (intermediate), and *Pp. whitei* (largest). The specific distinctions of these taxa, however, are periodically questioned, with some studies suggesting that only one or two species should be recognized. From 2012-2014, we reviewed all known *Parapapio* material from East and South Africa, reassessing the validity of these three *Parapapio* species using qualitative features, standard craniodental metrics, and 2d geometric morphometric data. Our results suggest that *Pp. jonesi* is perhaps the most distinctive species, exhibiting a small dentition relative to cranial size (significantly smaller than *Pp. whitei*), a highly peaked muzzle cross-section in the midline, and qualitative features such as prominent brow-ridges, a definitive sagittal crest, and a concavo-convex nasal profile. *Parapapio broomi* is quantitatively distinct from *Pp. whitei* and *Pp. jonesi* specimens in that it has a shorter face (nasion-prosthion), shorter palate, more rounded rostral cross-section, straighter nasal profile, broader upper molars, and qualitatively possesses a flatter muzzle dorsum. *Parapapio whitei* is the largest species dentally and, in addition to the features mentioned above, is recognized qualitatively by its more prominent, peaked nasals compared to *Pp. broomi* and slighter supraorbital region compared to *Pp. jonesi*. Thus, both qualitative and quantitative features examined here, in addition to previous analyses of molar size, are consistent with three *Parapapio* species in the South African Plio-Pleistocene.

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Lifestyle Changes and Immune Function: Associations between Immunoglobulin E Levels and Market Integration among Indigenous Shuar from Amazonian Ecuador

THERESA E. GILDNER[1], SAMUEL S. URLACHER[2], MELISSA A. LIEBERT[3], TARA J. CEPON-ROBINS[4], JOSHUA M. SCHROCK[1], FELICIA C. MADIMENOS[5], CHRISTOPHER J. HARRINGTON[1], J. JOSH SNODGRASS[1] and LAWRENCE S. SUGIYAMA[1]

[1]Department of Anthropology, University of Oregon, [2]Department of Anthropology, Hunter College (CUNY), [3]Department of Anthropology, Northern Arizona University, [4]Department of Anthropology, University of Colorado, Colorado Springs, [5]Department of Anthropology, Queens College (CUNY)

Market Integration (MI; the degree of consumption from and production for market economies) has a profound influence on human health. For instance, degree of MI shapes parasite infection risk by affecting routes of disease exposure (e.g., water source, bathroom type). Immunoglobulin E concentration (IgE; an important antibody in adaptive immune responses to extracellular pathogens) has been linked with the frequency and timing of parasite exposure over a lifetime; MI-linked changes in parasite infection are therefore hypothesized to influence IgE levels and adaptive immunity development. The present study tested how MI and IgE levels are related among the Shuar, an indigenous Ecuadorian population experiencing rapid and varied MI. We hypothesized that MI and IgE levels exhibit an inverse relationship, such that more market integrated Shuar have lower IgE levels. IgE levels were measured from dried blood spots using enzyme-linked immunosorbent assay analysis. Participants completed a Material Style of Life (SOL) Index measuring degree of participation in market-based or subsistence economy divided into three scales: Traditional Style of Life (T-SOL), Market-Integrated Style of Life (M-SOL), and Housing Style of Life (H-SOL). Data were collected from 615 Shuar participants (ages 1-86) and linear regressions controlling for factors associated with IgE levels (e.g., sex, age, BMI, infection status) were performed. Preliminary results suggest that IgE concentrations are positively associated with M-SOL, but negatively associated with H-SOL. These findings suggest that various aspects of MI affect IgE levels differently, thus providing insights into the effects of lifestyle change on a crucial component of immune function.

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Variations in aggressive encounters between tourists and a hybrid macaque group (*Macaca fascicularis* x *M. nemestrina*) in Sabah, Malaysia

LAUREN J. GILHOOLY and IAN C. COLQUHOUN

Anthropology, University of Western Ontario

Primate tourism has been heralded as an important conservation tool, though a significant drawback is that human-primate contact increases disease transmission risk. Macaques, in particular, have been studied at tourist locations where provisioning and physical contact are common. This study aimed to understand better how to improve primate tourism by observing human-macaque interactions when tourist behavior is guided by staff. We studied the behavior and ecology of a hybrid group of long-tailed (*Macaca fascicularis*) and pig-tailed macaques (*M. nemestrina*) at Sepilok Orang-utan Rehabilitation Center, a popular tourist destination in Sabah, Malaysia.

We hypothesized: 1) macaques would spend more time in close proximity (<10 m) to tourists during the high season; 2) tourist-macaque contact would be rare; and 3) tourist behavior would predict macaque aggression. We used instantaneous scan sampling and *ad libitum* sampling to assess tourist-macaque interactions from November 2016-August 2017.

Visitor attendance and the amount of time macaques spent in close proximity with tourists were weakly correlated. With food forbidden, most tourist-macaque interactions were peaceful. Macaques occasionally exhibited minor aggression, i.e. lunging. Aggression was not easily predicted and typically followed sustained eye contact, <3m proximity, and involved one of three specific macaques. We did not observe biting or scratching.

Macaque aggression was infrequent compared to sites featuring provisioning by tourists. Since macaques do not appear to be avoiding tourists, it is crucial that visitors' access to food is limited and their behavior monitored by staff to reduce macaque aggression, stress, and the potential for cross-species disease transmission.

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Application of a Developmental Model to Hominoid Supernumerary Molars

EVELYN S. GLAZE[1,2] and GARY T. SCHWARTZ[1,2]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Institute of Human Origins, Arizona State University

Supernumerary molars (SMs) are molars that develop in excess of a species' normal molar complement. They occur in low frequencies (4-11%) in all extant great apes and are even present in a few fossil hominins. SMs also occur in higher than expected frequencies in hybrids (baboons and mice), and so have been proposed as potential hard tissue markers of hybridization. The Inhibitory Cascade model, an experimentally-derived developmental model of mammalian molar size gradation, predicts that SMs are more likely to be present in individual apes with equally-sized second (M2) and third (M3) molars, which results from balanced activator and inhibitor signals during development. We test this prediction in a great ape sample (n=558) by assessing the relationship between M2 and M3 size and the presence or absence of SMs using Mann-Whitney *U* tests and RMA regressions. Equally-sized molars are correlated (Mann-Whitney $U = 9294$; $Z = -3.31$; $p < 0.001$) with SM presence in the mandibular, but not the maxillary, arcade. RMA regressions indicate isometry between M2 and M3 size in both arcades, regardless of whether or not SMs are present. We conclude that balanced activation and inhibition during molar development is a significant causal factor for the presence of mandibular SMs in nonhybrid great apes. This study is the first to examine the developmental basis of hominoid SMs within an evo-devo context, and thus provides a developmental foundation for interpreting SM presence in the hominin fossil record.

Variation in the trabecular structure of the 4th lumbar vertebra between obese and non-obese individuals

DEVORA S. GLEIBER, DEBORAH L. CUNNINGHAM and DANIEL J. WESCOTT

Forensic Anthropology Center at Texas State, Department of Anthropology, Texas State University

Obesity adds a biomechanical burden to the human body that should be reflected in the trabecular structure of the lumbar vertebrae. We conducted an assessment of the differences in trabecular architecture of the 4th lumbar vertebra in obese and non-obese individuals. High-resolution computed tomography was used to scan the 4th lumbar vertebra of ten obese and ten non-obese, age-matched females and males. A cubic volume of interest (VOI) was extracted from the center of the each vertebral body, and bone volume fraction, connectivity density, degree of anisotropy, and trabecular thickness and spacing were calculated for each VOI. Two-tailed t-tests show that obese females have less trabecular spacing than normal BMI females, while connectivity density, a proxy for trabecular number, is significantly greater in obese females. Both of these properties are nearly significant in males. Additionally, there is a nearly significant difference in bone volume fraction in both males and females, with obese individuals having a greater amount of bone in the VOI. Trabecular thickness and anisotropy are not significantly different for either sex. The results suggest that the biomechanical burden of obesity is reflected in the

trabecular structure of the lumbar vertebral body. The differences between obese and non-obese individuals are more pronounced in females and are due to the addition of trabeculae in obese individuals rather than an increase in the trabecular thickness. This study contributes to our understanding of how obesity affects the skeleton, and more broadly how bone reacts to mechanical usage.

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A test of the 'Brain Pleiotropy Hypothesis' for the relationship between brain size and dental development in rhesus macaques

HALSZKA GLOWACKA[1] and GARY T. SCHWARTZ[2,3]

[1]Department of Neuroscience, Washington University School of Medicine, [2]School of Human Evolution and Social Change, Arizona State University, [3]Institute of Human Origins, Arizona State University

Brian size is strongly positively correlated with the pace of dental development across primates and this correlation is used to inform fossil primate life-history reconstructions, yet the underlying cause for this relationship remains unknown. The 'Brain Pleiotropy Hypothesis' (BPH) is aimed at explaining this strong interspecific relationship. It posits that dental development is protracted in large-brained species as a consequence of prolonged brain growth. To test whether dental development and brain growth are linked pleiotropically, we determined whether they are intraspecifically related throughout ontogeny. Using existing cranial capacity (CC) data on *Macaca mulatta* individuals of known-age from the Cayo Santiago primate skeletal collection (n=361), curated by the Caribbean Primate Research Center, we determined the ages at CC growth cessation for females and males. We developed a score of molar development for a subset of these individuals (i.e., those younger than the ages at CC growth cessation; n=68) and extracted residuals from Ordinary Least Squares regressions of the relationships between (1) CC and age and (2) molar development score and age. We used Reduced Major Axis regression to determine whether there is a relationship between residual CC and residual molar development score. Results indicate that these residual values are not significantly correlated (females: slope=0.00, r=0.00, p=0.34; males: slope=0.02, r=0.00, p=0.92). Our results do not support the BPH and suggest that some other mechanism, not pleiotropy, is responsible for the interspecific relationship between dental development and brain size.

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Dental Metrics for Sex Estimation in Presumed Hispanic Migrants

TIMOTHY P. GOCHA[1,2] and KATE SPRADLEY[2]

[1]Anthropology, University of Nevada, Las Vegas, [2]Anthropology, Texas State University

The rise in migrant deaths at the South Texas border has created a humanitarian crisis that presents unique challenges to identification. Anthropologists with Operation Identification at Texas State University have received over 200 sets of human remains of presumed Hispanic migrants since 2013 and are actively engaged in identification efforts, including constructing a biological profile for each case. Though not common, some decedents are adolescents whose level of skeletal development can make it impossible to estimate sex based on standard pelvic or cranial morphology, or long bone metrics. However, these subadults often have near-fully developed dentition; therefore, the purpose of this study was to determine if dental metrics of the permanent dentition could be used to estimate sex in presumed Hispanic migrants.

The sample consists of 102 individuals (66 male, 36 female) of known sex, based on genetic testing (n=98) or presence of genitalia (n=4). Mesiodistal and buccolingual crown measurements were taken of all permanent dentition present. Independent sample t-tests confirmed canines are the most sexually dimorphic teeth (all p-values <0.05), with mandibular canines being ~6%, and maxillary canines being ~4% larger in males than females. Several logistic regression analyses were performed using various combinations of canine measurements. The calculated logistic regression models explained between 13.7-54.3% of the variation in sex, correctly classified between 65.3-80.0% of cases, and were statistically significant (all p-values <0.05). As such, when other methods of sex estimation are not possible, dental metrics can be useful in estimating sex of presumed Hispanic migrants.

Growth and Development of the Cartilaginous Distal Femur

CAROLINE R. GODFREY[1,2], HEATHER M. GARVIN[3] and LUIS L. CABO[2]

[1]Investigations, Harris County Institute of Forensic Science, [2]Applied Forensic Sciences, Mercyhurst University, [3]Anatomy, Des Moines University

The human lower limb undergoes numerous developmental changes during infancy in preparation for bipedal locomotion. Different biomechanical forces are exerted on the knee in newborns, crawling infants, walking infants and young children. For these reasons, we might expect shape changes to the distal femur corresponding to ages at which these locomotor milestones are achieved. This study aimed to test this hypothesis by extracting transverse outlines of the distal femur from a sample of postmortem multislice computed tomography scans from 88 modern individuals aged 0 to 4 years, and testing for outline shape differences between sexes and one-year age cohorts. Elliptical Fourier analysis was performed on the extracted outlines, followed by principal component analysis, regression analyses and M/ANOVA. MANOVA results indicate no significant sex differences in distal femur shape for PC1-4 (p = 0.154-0.780). Multivariate linear regression results did indicate significant effects of age on shape with an R2 0.425, but there were no significant correlations with individual principal components. The majority of variation between the age cohorts is explained by PC3, which appears to represent differences in the relative length of the lateral condyle and the shape of the anterior articular surface. These results provide preliminary support to the hypothesis that distal femoral shape changes in response locomotor development. These changes likely represent the knee joint's response to the action of the quadriceps tendon in bipedal locomotion. Future research can lead to a better understanding of the genetic and environmental influences on bone development and traits associated with upright walking.

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A new interpretation of Madagascar's megafaunal decline: the "Subsistence Shift Hypothesis"

LAURIE R. GODFREY[1], NICK SCROXTON[2], BROOKE E. CROWLEY[3], STEPHEN J. BURNS[2], MICHAEL R. SUTHERLAND[4], VENTURA R. PÉREZ[1], PETERSON FAINA[5] and LOVASOA RANIVOHARIMANANA[5]

[1]Anthropology, University of Massachusetts, Amherst, [2]Geosciences, University of Massachusetts, Amherst, [3]Geology and Anthropology, University of Cincinnati, [4]Mathematics and Statistics, University of Massachusetts, Amherst, [5]Sedimentary Basins, Evolution, Conservation (BEC), University of Antananarivo, Madagascar

Despite decades of research, disagreements remain regarding the relative importance of climate change and human activities as triggers for the Holocene extinction of Madagascar's megafauna. We use a multiproxy approach to investigate relationships between megafaunal decline, climate change, and habitat modification. Using maximum likelihood x^2 analysis of radiocarbon-dated extinct and extant vertebrate subfossils, we document the chronology of megafaunal decline. At first slow, its pace increased at

~700 Common Era (CE) and peaked at ~850 CE, before the transition from C_3- to C_4-dominated habitats in northwestern Madagascar. By 1050 CE, megafaunal populations, including large-bodied lemurs, had essentially collapsed. Neither their rapid decline beginning ~700 CE, nor previously documented vegetation transformation in the late 1st millennium, was triggered by aridification. However, both roughly coincided with the transition in human subsistence from hunting/foraging to herding/farming.

We offer the "Subsistence Shift Hypothesis" to explain megafaunal decline. This hypothesis acknowledges the importance of wild-animal hunting by early hunter/foragers, but more critically highlights negative impacts of the economic shift, expanding trade network, new settlement by immigrant groups, and expansion of the island's human population. While early megafaunal decline through hunting may have helped trigger megafaunal decline, the economic shift hastened the crash of megafaunal populations. The negative impact of human population size, which would have increased as reliance on agropastoralism grew, must be appreciated. Counterintuitively, and despite the availability of alternative resources, hunting pressure on wild animals may have increased with agropastoralism, and habitat modification likely had a compounding, negative effect on large-bodied, forest-dependent taxa.

Sex Differences and the Forensic Application of Skeletal Stress Markers: A Correlation Study of Dental and Postcranial Indicators of Non-Specific Stress

JUSTIN Z. GOLDSTEIN

Anthropology, New York University

Skeletal stress indicators have provided important bioarchaeological insights into prehistoric populations, but are rarely used in forensic contexts. Incorporating linear enamel hypoplasia (LEH)—a non-specific indicator of stress—into forensic biological profiles has proved a promising method for identifying and repatriating the remains of undocumented migrants. However, the relationship between LEH and other postcranial stress markers in recent populations is unknown. Furthermore, sex differences in trait correlations are not fully understood. This study considers sex differences and the relationships between LEH, Harris lines, cortical bone thinning, and stunted stature in a recent (1900's) skeletal collection through multiple regression models and correlation analyses. The correlations observed between Harris lines and cortical bone thinning (ranging from -0.289 to -0.559) tentatively supports the hypothesis that Harris lines are more indicative of periods of increased growth velocities than periods of malnourishment and arrested growth. However, future studies should consider the interaction between these measures histologically at higher resolutions. Despite the known differences in the long bone development patterns between males and females, no significant sex differences in postcranial trait expression were observed (p= 0.260). Additional results from the data condensed into new age groups (0-18, 19-34, 35-49, and 50+) are currently pending. Incorporating non-specific stress indicators into forensic analyses requires the independent consideration of traits coupled with an in-depth analysis of life history events. While not practical for all forensic case work, this approach might aid the identification and repatriation of individuals with sparse antemortem data, such as undocumented migrants or long unidentified individuals.

A 3D Analysis of the Ontogenetic Patterning of Human Subchondral Bone Microarchitecture in the Proximal Tibia

JESSE R. GOLIATH

Department of Anthropology, The Ohio State University, Defense POW/MIA Accounting Agency

The objective of this research was to test the hypotheses that ontogenetic patterns in tibial subchondral trabecular and cortical bone microstructure are age and condyle specific due to differential loading associated with changing joint kinetics and body mass. High-resolution computed tomography images were acquired for 31 human tibiae, ranging in age from 8 to 37.5 years. The skeletal samples are from Norris Farms #36 cemetery site, dating to A.D. 1300. Proximal epiphyses were digitally isolated for analysis using Avizo® Fire 6.2 and 8.1.1. Morphometric analysis of subchondral bone architecture was performed for 11 cubic volumes of interest, positioned within and between the tibial condyles within the epiphyseal region. Analysis of the subchondral cortical plate was accomplished through dual-threshold cortical masking. Findings indicate that age-related changes in mechanical loading have heterogeneous effects on subchondral bone morphology. With age, subchondral trabecular microstructure increased in bone volume fraction ($\alpha = 0.033$) and degree of anisotropy ($\alpha = 0.012$), and decreased in connectivity density ($\alpha = 0.001$). In the cortical plate, there is an increase in thickness ($\alpha = 0.000$). When comparing condylar regions, only degree of anisotropy differed ($\alpha = 0.004$) between medial and lateral condyles. The trabeculae in the medial condyle were more anisotropic than in the lateral region. The differential response of subchondral bone to changing mechanical loads during growth and development serves as a powerful tool to evaluate the significance of mechanical loading on adult bone morphology and can offer insights into adult morphological variation in joint health and disease.

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Examining variables associated with the underdiagnosis of depression in Mexico

AIDA M. GOMA PETIT[1], ALICIA M. DELOUIZE[1], KRISTIN E. YARRIS[2], GEETA EICK[1], ELIZABETH THIELE[3], AARON S. RODRIGUEZ[4], BETTY S. MANRIQUE-ESPINOZA[4], PAUL KOWAL[1,5,6], NIRMALA NAIDOO[5], SOMNATH CHATTERJI[5] and JOSH SNODGRASS[1]

[1]Department of Anthropology, University of Oregon, [2]Department of International Studies, University of Oregon, [3]Department of Biology, Vassar College, [4]Centre for Evaluation Research and Surveys (Mexico), National Institute of Public Health, [5]WHO Study on global AGEing and adult health (SAGE), World Health Organization (Switzerland), [6]Research Centre for Generational Health and Ageing (Australia), University of Newcastle

Depression is a leading contributor to disease burden worldwide. Although there are known and effective treatments for depression, far fewer than half of those affected by the disease will receive treatment, in part due to barriers in health care access contributing to underdiagnosis. Using the World Health Organization's Study on global AGEing and adult health (SAGE) Wave 1 dataset, this study examines older adults (50+ years old) in Mexico (n = 1,725) to determine factors that may lead to depression as determined by a symptom-based algorithm, but not self-reported clinical depression diagnosis. We hypothesized that men were more likely to have depression without a self-reported clinical diagnosis. Hierarchical logistic regression analysis was utilized to examine the effects of sex, age, education, wealth, marital status, social relationships, and residence location (urban vs. rural) on depression diagnosis. Model 1 showed that females were, in fact, more likely than males to have depression without a self-reported diagnosis (β= 0.60, p = 0.006), but age (β = 0.00, p = 0.71) was not significant. In model 2, being female was still a significant predictor of depression without a diagnosis (β= 0.62, p = 0.007) despite controlling for lower education (β = -0.03, p = 0.005) and more difficulty with interpersonal relationships (β = 0.45, p < 0.001). Age, wealth, marital status, and residence location (urban/rural) were not associated with undiagnosed depression. These findings highlight the importance of evaluating gender differences, improving education, and ameliorating social barriers to provide proper diagnosis and care for depression.

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Mapping host-microbe interactions from fecal samples: Immune and nutritional modulation by the primate gut microbiome

ANDRES GOMEZ[1,2] and KLARA PETRZELKOVA[3]

[1]Animal Science, University of Minnesota, [2]Integrated Animal Systems Biology Group, [3]Institute of Vertebrate Biology, Czech Academy of Sciences

Anthropologists have increasingly turn to microbiome analyses to expand the scope of their research questions; generating novel information in the context of primate ecology, nutrition, health and evolution. However, microbiome applications in primatological research have yet to explore how host and microbes interact, which could lay out the foundation to understand mechanistic insights on how the microbiome impacts primate physiology. To understand how gene expression in the tissue lining up the colonic epithelium correlates with species-specific bacterial configurations in the primate gut, we used metatranscriptomics targeting host cells, in tandem with metagenomics and metabolomics in 26 fecal samples of wild western lowland gorillas (*G.g.gorilla*) and humans (*H.sapiens*). The data show that despite the limited amount of host signals generated from fecal samples, unique gene regulation profiles distinguishing the colonic tissue of the two primate species correlate strongly with the abundance of particular metabolites and bacterial taxa. Specifically, while increased expression of genes involved in host metabolism and colonic tissue architecture in gorillas corresponded with higher abundance of phenolic metabolites; differential expression of immune-associated genes in humans was associated with lipidic metabolite pools and higher abundance of saccharolytic bacteria. These observations highlight the synergistic role of diet and the gut microbiome in impacting nutrition and immunity in primates, and underscore the pivotal role that diet could have had in microbe-primate diversification. The results also show that noninvasive profiling of host gene expression in fecal samples, along with microbiome analyses, are promising tools in different areas of biological anthropology.

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New Early Miocene primate bearing faunal assemblage from the Alto Madre de Dios, Peru

LAUREN A. GONZALES[1], RICHARD F. KAY[2], WOUT SALENBIEN[3], LUIS ANGEL VALDIVIA[4], GUSTAVO BEJAR[5], LAURA CHORNOGUBSKY[6], JEAN-NOËL MARTINEZ[4], CATHERINE A. RIGSBY[7] and PAUL A. BAKER[3]

[1]Biomedical Sciences, USCSOMG, [2]Evolutionary Anthropology, Duke University, [3]Nicholas School of the Environment, Duke University, [4]Instituto de Paleontologia, Universidad Nacional de Piura, [5]School of Geological Sciences and Engineering, Yachay Tech, [6]Div. Paleontología de Vertebrados, Museo Argentino de Ciencias, [7]Department of Geological Sciences, East Carolina University

Recent collecting efforts along the Alto Madre de Dios River in Amazonian Peru have resulted in the identification of several new fossil-bearing screen wash localities of Oligocene and early Miocene age. Preliminary findings reveal a rich micromammal assemblage yielding extremely small palaeothentid marsupials, bats, a primate, and jaws and hundreds of isolated rodent teeth identifiable to family and genus. More fragmentary larger remains include armadillos, interatheriids, toxodontids, litopterns, reptiles, and fish. All localities belong to the Bala Formation, the basal member of the Ipururo Group. U/PB dates on detrital zircons directly date the oldest locality to 30.3 ± 0.8 ma and constrain the primate-bearing locality to between 18.9± 0.7 and 17.1± 0.7 ma.

Most notable is the discovery of an unworn upper molar of a new genus of primate that is distinctively different from any known late Oligocene or Miocene primate, particularly for its exceptional small size (similar to *Cebuella pygmaea*). Other significant finds include the recovery of a series of rodent teeth and jaws from the early Miocene locality, including a variety of hypsodont and brachidont forms. A lower molar of cf. *Microscleromys* is much smaller than the type and reference material from the middle Miocene La Venta fauna of Colombia and may represent the smallest known caviomorph rodent living or extinct. Other teeth are tentatively identified as belonging to cf. *Eoviscaccia* that ranges from Early Oligocene to Early Miocene in Chile, Bolivia, and Argentina, but is absent from the middle Miocene in either Colombia or Bolivia.

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2D- and 3D-Micromorphological Cutmark Analyses

ARYSA GONZALEZ R.[1], CHRISTOPHER W. SCHMIDT[1] and BRIANA POBINER[2]

[1]Anthropology, University of Indianapolis, [2]Anthropology, Smithsonian Institution

Identifying tool types by analyzing cutmark profiles is a promising methodology for understanding cutmark variables. Previously, cutmark analyses relied on optical and SEM microscopy and were largely restricted to gross observations of magnified cutmark morphology. The application of a white-light confocal profiler (WLCP) allows for the creation of 2D and 3D surface reconstructions based on detailed topographic studies. Two- and three-dimensional parameters such as surface area (μm^2), volume (μm^3), depth (μm), slope, and angle can be used to distinguish cutmarks made with different types of tools. The current study seeks to refine recently established WLCP cutmark analysis methods by attempting to distinguish experimentally-created cutmarks. Cutmarks (n=51) were generated on deer long bones with worked flakes made from three different stone raw materials (basalt, chert, and obsidian) as well as steel knives. Emphasis was on 2D variables from profiles taken at or near cutmark midpoints. Cut width, depth, angle, and slope successfully distinguished steel and stone tools (ANOVA, $p = < 0.001$). Among the stone tools, discriminant function analysis determined that 94.1% of the cutmarks could be correctly classified as either stone or steel. Stone cutmarks were correctly classified 91.7% of the time as either basalt or chert/obsidian. The results support white-light confocal profilometry as a useful means of cutmark analysis. We anticipate that further refinement will generate methods that can be reliably applied to bones from archaeological contexts.

The evolution of human facial sexual dimorphism

TOMAS GONZALEZ[1], JULIE WHITE[1], ARSLAN ZAIDI[2], PETER CLAES[3] and MARK D. SHRIVER[1]

[1]Anthropology, Pennsylvania State University, [2]Department of Biology, Pennsylvania State University, [3]ESAT/PSI, KU Leuven

Modern human facial variation is integral to social and ecological interactions and can yield important insights into recent human evolution. One important aspect of facial variation, critical to consider in terms of facial evolution, is sexual dimorphism. We tested whether human populations show differences in patterns of facial sexual dimorphism (FSD), that is, whether there are differences in the morphological regions that change as a product of sex. Such differences could indicate differential pressures of sexual selection across human populations. Briefly, we applied a geometric morphometrics approach utilizing a dense mesh of 6,790 quasi-landmarks (QLs) to 3D facial scans from 3,646 participants of various ancestries. Populations were defined by comparison to the 1000G Phase 3 reference using ~10,000 single nucleotide polymorphisms. We used Principal Component Analysis on the superimposed QLs to reduce the number of variables, and to summarize facial shape changes. We defined FSD as a vector estimated by the difference between female and male average PC coordinates. Moreover, we decomposed FSD into allometric and non-allometric components using height as proxy for size. Comparing patterns of FSD across populations, we found that African and East Asian populations show a similar pattern of FSD, while South Asian, Indigenous American, and European are similar to each other (significant p-values<0.05, 10,000 permutations). We discuss our findings in light of recent human evolution and admixture.

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How epidemics devastated the indigenous people of the Americas

ROLANDO GONZALEZ-JOSE and VIRGINIA RAMALLO

Instituto Patagónico de Ciencias Sociales y Humanas, CENPAT-CONICET

There is growing consensus around the idea that much of our understanding on the causality of genetic plus environmentally based diseases and other complex phenotypes including susceptibility and/or resistance to pathogens is to be deciphered by exploring the fine-scale study of human genetic variation. When extrapolating this idea to the native populations, the challenge is greater due to the remarkable genetic variation that scientists have found within several regions of the Americas. After Columbus´ landing in the Americas, the populations of the American continent experienced a precipitous decline. Even though the spread of pathogens of European origin across nonimmune Native American is suspected to be responsible for a great proportion of the post-contact mortality, the situation cannot be extrapolated straightforwardly to all the New World populations. In fact, the local genetic, environmental, and cultural particularities of the contact need to be considered in order to achieve a more sophisticated picture. Here I present some recurrent patterns regarding how epidemics devastated the indigenous people of the Americas. Specifically, I will focus on pattern similarities among the population decline of the Chumash (California) and Fueguians (Patagonia). A statistical comparison indicates that decimation coincides with mission establishment. The concomitant increase in number of baptisms is almost-synchronically followed by a 15%/year of increasing in mortality each year, indicating a strong effect of density changes as a trigger to epidemic disease impact. Furthermore, I will discuss genetic and non-genetic factors that potentially generated deviations from the expected patterns of mortality due to infectious diseases.

A comparative growth study between children from the medieval Islamic and medieval late Christian Periods in Santarém, Portugal

ELLIE GOODERHAM[1], ANTONIO MATIAS[2], SARAH WALSHAW[3], JOHN ALBANESE[4] and HUGO F.V. CARDOSO[1]

[1]Archaeology and Centre for Forensic Research, Simon Fraser University, [2]Câmara Municipal, Santarém, [3]History, Simon Fraser University, [4]Sociology, Anthropology, and Criminology, University of Windsor

Growth stunting and higher frequencies of skeletal indicators of stress in children are associated with disadvantaged or stressed populations. This study examines differences in long bone growth between two juvenile samples from Santarém, Portugal, from the 8th to 17th centuries AD. The earlier sample (n=24) spans the period of Islamic rule (8th-12th centuries AD) during which time, the Iberian Peninsula experienced occupation but also a period of enlightenment associated with the Golden Age of Islam. The later sample (n=17) spans the post-Islamic medieval Christian Period (13th-17th centuries AD) and was thought to have different secular and social practices, which could impact population health, through a variety of means, including diet, medicine, and hygiene. Long bone length-for-age plots were calculated for the humerus, radius, femur, and tibia and were compared with Maresh's reference data. Age specific z-scores for bone length were also calculated and the sample z-score means compared. The medieval Christian children were always smaller (mean z-score varied between -1.19 and -3.05) than the medieval Islamic children (mean z-score varied between -0.97 and -1.54) but the differences were not statistically significant. When examining both the Islamic and Christian samples in more detail by grouping the samples by historical context within a period, significant variation in z-score means were observed and seemed to reflect the internal dynamics of these two periods. This research indicates that analyzing each population as a whole might mask a more complex narrative when examining growth and studying stress in these two periods of time.

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Age-related changes in the structural properties of the human tibia

ALICE F. GOODING[1], ADAM D. SYLVESTER[2] and BENJAMIN M. AUERBACH[3]

[1]Department of Geography and Anthropology, Kennesaw State University, [2]Center for Functional Anatomy and Evolution, The Johns Hopkins School of Medicine, [3]Department of Anthropology, The University of Tennessee

Bone loss with age is regarded as nearly universal among modern humans. However, it remains unclear whether and at what age(s) bone geometry shifts to adapt to the physiological and mechanical demands that accompany aging. Because of their role in locomotion, elements of the lower limb are expected to be mechanically sensitive to age-related bone loss. Here we examine changes in the tibia diaphysis as a function of age, body mass, and activity level.

Cross-sectional geometric properties at five diaphyseal sites (20, 35, 50 and 80% of bone length) were extracted from computed tomography scans of 208 tibiae (n = 90 females, 118 males, aged 40-99 years) that are part of the Bass Donated Skeletal Collection. Body mass index (BMI) and activity level during life were recorded from collection documentation. Neither sex demonstrated significant changes in tibial strength and rigidity as age increased, except increases in both properties in females over the age of 80. Cortical mass is lost from decade to decade, but results indicate the tibia adapts its geometry to maintain cross-sectional properties. Greater activity level and BMI were correlated with greater bone mass, strength, and rigidity. However, above moderate activity level and BMI, CSG properties did not continue to increase. The tibia therefore exhibits a potentially narrow range of sensitivity to factors that influence its mechanics, with shape change unobserved above a certain level of loading. Furthermore, the geometric properties in the tibia are maintained with age, and mitigate the effects of cortical mass loss with aging.

Free-ranging access improves the gut microbiome of captive *Eulemur*

SARAH R. GORVETZIAN[1], LYDIA K. GREENE[1,2] and CHRISTINE M. DREA[1,2,3]

[1]Evolutionary Anthropology, Duke University, [2]University Program in Ecology, Duke University, [3]Biology, Duke University

The gut microbiome (GMB) is a critical promoter of primate health, but suboptimal diets can lead to dysbiotic relationships between hosts and their microbes. It was recently shown that folivorous primates hosted a 'humanized' GMB in captivity, but that free-ranging access could offset microbial dysbiosis. Nevertheless, we lack understanding about the influence of captive conditions, in relation to host ecology and evolution, in regulating the GMB of non-folivorous primates. We therefore probed the GMB in seven species of frugivorous strepsirrhines known for their ecological resilience. Our subjects were 51 *Eulemur* (6 *E. collaris*, 13 *E. coronatus*, 14 *E. flavifrons*, 2 *E. macaco,* 11 *E. mongoz,* 3 *E. rubriventer,* 2 *E. rufus*) maintained with different diets and captive conditions at the Duke Lemur Center, in North Carolina. Whereas some groups gained access to forested enclosures where they could forage on local vegetation, others did not. Using amplicon sequencing of DNA extracted from fecal samples, we found that the *Eulemur* GMB in captivity neither varies with host species nor correlates to species' evolutionary divergence times. Free-ranging access, however, was associated with a richer and more diverse GMB that was compositionally distinct and specifically less dominated by *Prevotella*. The tradeoff between microbial diversity and *Prevotella* likely reflects differential access to dietary foliage and is emerging as a potentially informative relationship across lemurs. Ongoing work in Madagascar, focused on sympatric species of *Eulemur*, will confirm if these patterns are unique to captivity. This study has implications for the dietary health and husbandry of frugivores.

A muscle synergy-based analysis of the trunk and hindlimb muscle activation patterns during quadrupedal and bipedal walking in Japanese macaque, white-handed gibbon, and human

RYOSUKE GOTO and YOSHIHIKO NAKANO
Graduate School of Human Sciences, Osaka university

Neuromuscular conservation hypothesis suggests that activation patterns of hindlimb muscles during quadrupedal walking are conservative. However, it is not yet known if the activation patterns of trunk and hindlimb muscles are maintained across quadrupeds and bipeds, and whether the activation patterns during bipedal walking of hominoids are similar or not. To address the questions, we collected 12 or 13 channel EMGs of trunk and hindlimb muscles in three species: Macaca fuscata, Hylobates lar, and Homo sapiens. Based on a muscle synergy model, a multivariate analysis was applied to the EMGs, and we extracted temporal and spatial patterns of muscle synergies to compare them among the three species. The muscle synergy is a muscle group that consists of co-activating muscles, which has been considered as a basic unit of the neural control component. The temporal pattern of the synergy represents a phase when the synergy activates, and the spatial pattern represents muscles recruited in the synergy. Our results showed that the temporal and spatial patterns of the several muscle synergies of gibbon and human were generally similar. On the other hand, one of the synergies differed between the macaque and hominoids, which activated at touchdown of ipsi- and contralateral hindlimb in the hominoids, but not in the macaques. At the hindlimb touchdown, the decelerative substrate reaction forces would destabilize the trunk. Therefore, we concluded that the temporal patterns of the muscle synergy had been modified in the hominoids to stabilize the trunk during bipedal walking.

'Ague', 'Spring Ill' and 'Fever Terciane': Vivax Malaria and Social Constructions of 'Otherness' in the Anglo-Saxon Fens of England (AD 500-1050)

REBECCA L. GOWLAND[1], LISA BRUNDLE[2] and GAYNOR WESTERN[3]
[1]Archaeology, Durham University, [2]Archaeology, Christ Church Canterbury University, [3]Archaeology, Ossafreelance

The history of endemic malaria in Britain has gained increasing attention over recent years due to escalating concerns surrounding climate change and the re-emergence of infectious diseases. This study integrates palaeopathological, historical and archaeological evidence to explore the role of endemic disease ecology in the social construction of marginal fenland identities (AD 500-1050). Mortality records from the 16th centuries in Britain indicate that *Plasmodium vivax* was a significant contributing factor to high morbidity and mortality in wetland environments. Malaria is thought to have been introduced during the Roman occupation (AD 43-410) and the 9th century medical text Bald's Leechbook refers to the presence of 'spring ill' – a malaria-type disease, which manifested seasonally. A previous epidemiological analysis by the authors highlighted hotspots of *cribra orbitalia* in areas historically associated with malaria and its anopheles vector. The wetlands of Eastern England have been the subject of numerous myths and the inhabitants of these damp and misty places were often characterised as 'other'. It is recorded that St. Guthlac, who lived in the fenlands in the 8th century, was forced to ward off supernatural attacks upon his person, involving extremes of bodily temperature, which could possibly represent fever-induced hallucinations associated with malaria. This study utilises GIS to identify correlations between the bioarchaeological and historical evidence for putative malaria and stylistic idiosyncrasies in material representations of the fenland body. This study provides the first examination of the role of disease ecology in creating liminal landscapes, mythologies and regional identities in the past.

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Body size estimates of Miocene fossil apes and predicting mass across phylogenetic time

MARK GRABOWSKI[1,2,3], KEVIN G. HATALA[3,4], THOMAS F. HANSEN[2] and WILLIAM L. JUNGERS[5,6]
[1]Paleoanthropology, Senckenberg Centre for Human Evolution and Palaeoenvironment (HEP), University of Tübingen, [2]Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences, University of Oslo, [3]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, [4]Department of Biology, Chatham University, [5]Association Vahatra, [6]Department of Anatomical Sciences, Stony Brook University

Humans are relics of an adaptive radiation of apes that flourished in the early Miocene. Thus, reconstructing the paleobiology of these early apes is a necessary step to understanding the earliest phases of human evolution. Estimates of body size in Miocene apes can potentially provide new information on locomotion, life history, and dietary requirements. Previous attempts to estimate body mass in Miocene fossils have generally used limited comparative samples of extant apes and were often conducted on a case-by-case basis following new fossil discoveries. However, the choice of a comparative sample directly impacts body mass predictions and becomes more difficult for fossils that may have fundamentally different Bauplans than any living taxa. Here we present a new approach for estimating body mass that incorporates phylogeny and measurement error. We use this approach and a wide comparative sample of over 30 extant primate species to produce new and comprehensive body mass prediction equations based on postcranial traits. We then predict body mass for over 50 individual Miocene ape fossils and calculate averages for taxa including *Morotopithecus*, *Sivapithecus*, and *Oreopithecus*. Results suggest that early apes varied substantially in body size until around 10 Ma, after which larger bodied great apes appear to be the majority of recovered taxa. We find substantial size variation within some taxa (e.g. *Proconsul*) that exceeds any extant primate genus. Overall, our findings suggest body size was highly evolvable within early hominoids, adding to the comparative lens through which to view early human evolution.

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Is the Human Gut Microbiome Defined by Diet? A Comparison of Prehistoric Native American and Modern Rural African Data

RUTH E. GRADY[1] and KARL J. REINHARD[2]
[1]Anthropology, University of Nebraska - Lincoln, [2]School of Natural Resources, University of Nebraska - Lincoln

The characterization of the human gut microbiome through molecular biology is a new approach to coprolite analysis. This approach foreshadows the future of coprolite analysis which will involve standard reconstruction of diet and complementary DNA analysis. Standard reconstruction is based on identification and quantification of macroscopic remains and microscopic remains. By relating ancient diet to the evolving microbiome, the approach will be more relevant to physical anthropology. The gut microbiome of coprolites from the 1,300 year-old Mexican site of Rio Zape has been characterized. Those published data show similarity between this New World prehistoric microbiome with that of modern African rural communities in Burkina Faso. We analyzed the microscopic and macroscopic dietary remains from Rio Zape including seeds, fibers, plant epidermis, bone and pollen. We find that this diet was reliant primarily on maize and agave. Other components included beans, squash, walnuts, pine nuts, goosefoot and prickly pear. These data were compared to published data for rural diets in rural Burkina Faso. The comparison shows that diverse diets characterize modern rural Africans and prehistoric Native Americans. Both diets are predominantly vegetarian meaning low in fat and animal protein. Both are rich in starch, fiber, and plant polysaccharides. This study begins to answer one key question in microbiome research: is there a possible correlation between bacterial diversity and diet? In this case, both microbiomic and paleonutritional analyses from very different cultures answer that question in the affirmative.

An XROMM analysis of midfoot mobility in non-human primates

MICHAEL C. GRANATOSKY[1], MYRA F. LAIRD[1], SHARON KUO[2], ZERESENAY ALEMSEGED[1] and CALLUM F. ROSS[1]

[1]Organismal Biology and Anatomy, University of Chicago, [2]Department of Pathology and Anatomical Sciences, University of Missouri

During stance phase of human walking the heel and midfoot lift simultaneously, accompanied by dorsiflexion at the metatarsophalangeal joints. In contrast, in non-human primates a midfoot break precedes dorsiflexion at the metatarsophalangeal joint. Based on these foot kinematics, osteological correlates of midfoot stiffness have been advanced as evidence of bipedality in fossil hominins. While initial descriptions located the midfoot break solely in the calcaneocuboid joint, recent work suggests contributions from both the tarsometatarsal (4th and 5th) and talonavicular joints. Furthermore, functional studies suggest that modern humans exhibit considerable variation in midfoot stiffness during locomotion, and midfoot stability in humans is often transient. Such variation suggests that midfoot stability in early hominins was not achieved solely by passive osteological features, but also by muscle-driven modulation of foot compliance. The UChicago XROMM (X-ray reconstruction of moving morphology) Facility makes possible precise 3D kinematics of the non-human primate midfoot, enabling testing of hypotheses regarding osteological correlates of midfoot kinematics. We used XROMM workflow to visualize the three-dimensional movements of the midfoot during quadrupedal locomotion in *Macaca mulatta*. During most strides, a majority of the movement responsible for the midfoot break was at the 4th and 5th tarsometatarsal joints followed by dorsiflexion at the talonavicular joint. However, the relative contribution of movement at each joint was variable between strides suggesting that the midfoot joints are best considered as functionally tuneable structures. These data speak to the importance of empirical studies for understanding animal movements, and the risks of interpreting function based on anatomy alone.

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The Analysis of Interred Pig Legs in Dartmoor Bog using Portable X-ray Fluorescence Spectroscopy

GUINEVERE GRANITE[1] and ROBERT PALFREY[2]

[1]Surgery, Uniformed Services University of the Health Sciences, [2]Archaeology, University of Exeter

Our Exeter University archaeology research team buried three pig legs approximately 20 centimeters (cm) below the surface in the Dartmoor bogs of southern Devon, England for ten months. To understand the bog environmental chemistry and its potential diagenetic effects on buried porcine remains, we applied Portable X-ray Fluorescence Spectroscopy (PXRFS) to the pig bone and burial soil. PXRFS is a non-destructive analytical technique that provides objective, on-site information concerning elemental composition.

To assess the potential diagenetic effects of the bog, we analyzed the elemental concentrations of Iron, Lead, Molybdenum, Strontium, Zinc, and Zirconium in the recovered pig bone and burial soil. The significantly higher elemental concentrations of Iron, Lead, Molybdenum, and Zirconium lead to the suggestion that elemental incorporation occurred for those elements in the bog. The low levels of Strontium and Zinc may indica te elemental leaching occurred for those elements in the bog.

PXRFS provides valuable information about the interactions between the bog environment and interred remains. That such chemical changes occurred within less than a year, supports a theory that the chemical processes involved in creating a bog body may occur within a short amount of time compared to archaeological timescales.

Ontogeny of female dominance in ring-tailed lemurs: behavioral and hormonal evidence

NICHOLAS M. GREBE[1] and CHRISTINE M. DREA[1,2,3]

[1]Evolutionary Anthropology, Duke University, [2]Biology, Duke University, [3]University Program in Ecology, Duke University

Female social dominance in ring-tailed lemurs (*Lemur catta*) has been extensively characterized in observational studies, yet examinations of its development and proximate mechanisms are still lacking. Specifically, it is unknown how and in what forms female dominance is reflected during development. To address these questions, we recorded behavior and assayed biomarkers from 23 ring-tailed lemurs housed at the Duke Lemur Center across a period of 30 months. Behavioral observations were performed opportunistically from 3-30 months of age (315 hours of total observation). From blood samples collected approximately every three months during the study period, we performed enzyme immunoassays to assess concentrations of testosterone (T), androstenedione (A_4), estradiol (E_2), and insulin-like growth factor (IGF-1); *n* = 107-198. Concentrations of sex steroids were mostly below detectable limits before surging at puberty (21-24 months). Consistent with previous findings in adult ring-tailed lemurs, we observed primate-typical sex differences in mean T and A_4, but comparatively smaller sex differences in A_4. Averaging across the juvenile period, we find that males play longer and more initiate play more frequently than females. Interestingly, A_4 concentrations peaked before puberty and coincided with reduced rates of play in females, but not males, which may indicate a potential mechanism for female dominance that warrants further investigation. Future analyses will build latent trajectories of behavior and hormones to generate predictions for any time point during the study period.

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Three-dimensional morphology and comparative anatomy of the *Australopithecus sediba* scapula

DAVID J. GREEN[1,2], STEVEN E. CHURCHILL[2,3], MARISA E. MACIAS[3], PHILIPP GUNZ[4], KRISTIAN J. CARLSON[5], PETER SCHMID[2,6] and LEE R. BERGER[2]

[1]Department of Anatomy, Midwestern University, [2]Evolutionary Studies Institute and Centre for Excellence in PalaeoSciences, University of the Witwatersrand, [3]Department of Evolutionary Anthropology, Duke University, [4]Department of Human Evolution, Max Planck Institute, [5]Department of Cell and Neurobiology, Keck School of Medicine, University of Southern California, [6]Anthropological Institute and Museum, University of Zurich

Preliminary analysis of the MH2 scapula (*Australopithecus sediba*) placed it intermediate between modern humans and African apes – as one might expect for an extinct hominin. However, the same is also true for *Pongo* – particularly in scapular spine and glenohumeral joint orientation – despite marked locomotor differences and phylogenetic distance. These unexpected affinities between MH2 and *Pongo* prompt further questions: are they primitive retentions from a *Pan*/*Homo* last common ancestor (LCA) with a *Pongo*-shaped scapula, or homoplasies, if the LCA's scapula was African apelike? Recent geometric morphometric considerations utilizing semilandmark representations of scapular fossa boundary outlines have clarified differences among *Pongo* and other extant hominoids, but the fragmentary hominin scapular fossil record often precludes such considerations. Fortunately, the *in silico* reconstruction of the complete MH2 scapula enables these three-dimensional comparative approaches.

The MH2 infraspinous fossa is similar to *Pongo* and *Homo* with a more horizontally-oriented spine, wider superoinferior breadth, and moderate axillary border length. Conversely, with a prominent, laterally-positioned superior angle, the MH2 supraspinous fossa aligns more closely with *Pan* and *Gorilla*. The MH2 subscapular fossa is also African apelike in being superoinferiorly broad and mediolaterally constricted, as apart from *Homo*, and markedly distinct from narrower, longer *Pongo* scapulae. These results suggest that many similarities between *Pongo* and MH2 are convergent, rather than plesiomorphic. Furthermore, broad similarities among MH2, *Pan*, and *Gorilla* support the hypothesis that the LCA had an African ape-like scapular blade

shape, while key differences from later *Homo* suggest that *A. sediba* maintained a semi-arboreal lifestyle.

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Interpreting intra-population variability from dental morphology and tooth dimensions of a modern Japanese population

MADELYN K. GREEN[1], SEAN D. TALLMAN[1,2] and YOSHIKATSU NEGISHI[3]

[1]Department of Anatomy and Neurobiology, Boston University, [2]Department of Anthropology, Boston University, [3]Department of Anatomy, Jikei University

Ancestry assessments in bioarchaeology and forensic anthropology are best analyzed with population-specific methods. Through population-specific ancestry methods, the generalized Asian ancestry category can be better refined to reflect the diversity of Asiatic people. Individuals from a modern (~1900 to present) Japanese population housed at Jikei University reflect a relatively unbiased population sample, as demographics range from juveniles to adults, with both sexes being equally represented. This broad sampling of individuals from the greater Tokyo region enables researchers to explore the degree of variation within the Japanese population, as can be demonstrated osteologically. Dentitions are an ideal candidate to measure intra-population variability due to heritabilities of both their tooth size and dental morphological characteristics within populations. In an attempt to better understand Japanese-specific intra-population variation, dental morphology and tooth dimensions were recorded from 201 individuals using the Arizona State University Dental Anthropology System (ASUDAS) and mesiodistal and buccolingual measurements, respectively. Tooth size and dental morphology data were compared between individuals using univariate and ANOVA statistical testing, reporting insignificant ($p>0.05$) results. Japanese tooth sizes and dental morphological traits exhibit limited variability within the sample, inferring that it is possible to make population-specific ancestry methods using dental techniques. This dental homogeneity is likely due to the fairly insular Japanese population history. Further, intra-population sampling and testing of dentitions from different collections in Japan will further validate that population-specific methods are indispensable for ancestry investigations. A better understanding of variation within Asiatic populations will aid in the development of population-specific ancestry methods.

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Dietary foliage regulates the gut microbiome and colonic metabolome of captive Coquerel's sifakas

LYDIA K. GREENE[1,2], ERIN A. MCKENNEY[3], THOMAS M. O'CONNELL[4] and CHRISTINE M. DREA[1,2,5]

[1]University Program in Ecology, Duke University, [2]Evolutionary Anthropology, Duke University, [3]Applied Ecology, North Carolina State University, [4]Otolaryngology, Indiana University School of Medicine, [5]Biology, Duke University

The gut microbiome (GMB) of folivores symbiotically converts dietary fiber into nutrients critical to host survival; however, in captivity, starchy diets may disrupt this function. To test if dietary quality contributes to the challenges of maintaining healthy folivores in captivity, we probed the structure and function of the GMB in the Coquerel's sifaka (*Propithecus coquereli*). Although this species is the only folivorous strepsirrhine to survive well in captivity, it is susceptible to fragile gut health. At the Duke Lemur Center, in North Carolina, sifakas receive a daily diet that is supplemented with a blend of local foliage in summer (summer diet), but with only winged sumac (*Rhus copallinum)* in winter (winter diet), with dietary transitions occurring abruptly in fall and spring. Over a calendar year, we collected fecal samples from 31 sifakas and assayed their GMB and colonic metabolome. When receiving summer (vs. winter) diets, sifakas hosted GMBs that were richer and more diverse, enriched for cellulose-degrading bacteria, but diminished in starch-degrading bacteria. These shifts occurred within days. When consuming summer diets, metabolomics were enriched for acetate and glutamate that were inversely correlated to butyrate, indicating significant alterations in protein and fiber metabolism. This study provide compelling evidence that even minor shifts in foliage diversity can lead to significant shifts in the GMB and its capacity for energy harvesting and nutrient production. These results contribute to our understanding of the Coquerel's sifaka's dietary needs when adjusting to captivity, and provide clues to improve husbandry strategies for folivorous primates, more generally.

Reproductive and parental investment strategies in ancient California hunter-gatherers

ALEXANDRA M. GREENWALD

Center for Evolution and Medicine, Arizona State University, Department of Anthropology, University of California, Davis

Human behavioral ecology predicts that individuals alter reproductive strategies to maximize reproductive success in response to environmental and social conditions. I employ stable isotope measures (δ15N and δ13C) of weaning age, parental provisioning, and child foraging derived from serial micro-samples of first molar dentin as proxies for the reproductive strategies employed by prehistoric hunter-gatherer populations from Central California over a 6,000-year period. Shifts in weaning age and childhood diet over evolutionary time scales suggest reduced parental investment associated with the Medieval Climatic Anomaly (MCA) (1100-700 BP), a period noted for severe episodic droughts and general environmental and social disruption. The decline in mean weaning age and associated shortening of inter-birth intervals during the MCA is consistent with the hypothesized offspring quantity-quality trade-off. This shift is primarily driven by reduced investment in male offspring coincident with greater extrinsic mortality experienced by males in all age cohorts as a result of increased rates of violent conflict. This change in life history strategy initiated a cycle of population growth and resource intensification that drove adaptive shifts in settlement patterns and socio-political structure, ultimately resulting in native Californian's high population density and unique tribelet organization.

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Anatomical Reconstruction in a Case of Syondyloepiphyseal Dysplasia from Uzbekistan

SEAN Y. GREER[1], DAVID W. HANSEN II[2] and ELISSA BULLION[3]

[1]Pathology and Anatomical Sciences, University of Missouri School of Medicine, [2]Department of Sociology and Anthropology, Nazarbayev University, [3]Department of Anthropology, Washington University in St. Louis

Osteochondrodysplasias are a large and diverse group of rare disorders relating to perturbations in the growth and development of skeletal and cartilaginous tissues. Classified by lesion location and types of tissues affected, there are scores of distinct forms including well known examples such as achondroplasia and osteogenesis imperfecta. Here, we describe a set of remains (TBK08) from the site of Tashbulak in Uzbekistan with skeletal characteristics consistent with a spondyloepiphyseal dysplasia.

The remains of TBK8 present with decreased long bone length, severe systemic osteoarthritis, and stenosis of the foramen magnum. Secondary anatomical pathologies associated with the severe degenerative changes seen in the joints were also observed. These include contracture of joints with growth of interlocking surface and marginal osteophytes, occlusion of intervertebral foramina, and short stature. Through a careful anatomical assessment of the skeletal remains, we are able to glean a significant amount of information about TBK8's physical state near the end of his life. This includes estimating his mostly frozen immobile body position, and identifying

anatomical regions likely suffering denervation and paralysis. Such a reconstruction raises broader questions about the implications of severe disease states not only on the individual, but on the surrounding society as a whole.

Pathologies almost inevitably effect more than one organ system by way of pathophysiological association or anatomical relatedness. While this means much information is lost in a skeletal only assessment, careful anatomically based analysis of osteological remains can lead to a reasonably complete reconstruction of disease presentation in an individual

Resistance to change 'In the Wake of Contact': Geographic origins and mortuary practices in 3rd millennium BC Arabia

LESLEY A. GREGORICKA

Sociology, Anthropology, & Social Work, University of South Alabama

During the Umm an-Nar period (ca. 2500-2000 BCE), southeastern Arabia's growing involvement in a pan-Gulf interaction sphere with core areas such as Mesopotamia – as well as the development of monumental architecture and the domestication of the date palm – mirrored growing social hierarchies as labor was increasingly organized, and traded goods and resources managed. While the external influence of core contact on 'peripheral' populations has largely been the focus of past archaeological inquiry, internal social change and local response to contact must also be explored. In conjunction with mortuary treatment, biogeochemical analyses of teeth can offer important insight into the nature of interactions between local communities and their trading partners.

Strontium ($^{87}Sr/^{86}Sr$: 0.70887±0.00021, 1σ) and oxygen ($\delta^{18}O_c$: -2.7 ± 0.8‰, 1σ) isotope data from the enamel of 98 individuals were evaluated to examine the biosocial implications of contact on Umm an-Nar communities. Homogeneous isotope values throughout the region confirm the adoption of a more sedentary lifestyle, and the presence of both sexes and all age groups in these tombs suggests that despite hierarchical changes among the living, all members of the community continued to be interred together, possibly indicative of attempts to downplay social tension but also reflective of resistance to performances of stratification in death. Moreover, the presence of a handful of non-local individuals buried without distinction in these tombs may point to the absence of a strong hegemonic reach by the core over local populations, as traditional, kin-based mortuary practices were maintained despite external contact and influence.

Head stability during bipedal walking in *Hylobates lar* and implications for foramen magnum position

NEYSA GRIDER-POTTER[1], RYOSUKE GOTO[2], KENJI OKA[3] and YOSHIHIKO NAKANO[2]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Department of Human Sciences, Osaka University, [3]School of Rehabilitation, Osaka Kawasaki Rehabilitation UniversityOsaka Kawasaki Rehabilitation University

An anterior foramen magnum is one of the defining characteristics of the hominin lineage and has been historically associated with bipedal locomotion. Recent work has demonstrated that species who are habitually bipedal have relatively anteriorly placed foramina magna when compared to their non-bipedal relatives. However, the functional advantage offered by this placement has yet to be experimentally determined. The head is modeled as a first-class lever with the atlantooccipital joint as its fulcrum. As such, we hypothesize that foramen magnum position affects head stability and predict that a more posterior foramen magnum will increase locomotor head motion in comparison to habitual bipeds.

To begin testing this hypothesis, three-dimensional head motion data were collected from a facultative biped, Hylobates lar. Four cranial landmarks were tracked during bipedal locomotor strides using four synchronized Sony Handycams at Osaka University. Landmarks were digitized in Frame DIAS and analyzed using R. Pitch, yaw and roll were determined in the global reference frame for a total of 19 bipedal strides, ranging in speed from 0.8 to 1.4 dimensionless velocity.

Results show that the ranges of head motion were greatest in the non-sagittal planes, especially in head roll. However, all values exceed that found in normal human walking. These results suggest differences head stability between habitual and facultative bipeds. Additional comparative research is needed to determine if this decrease in head stability is due to speed or anatomical factors. This work will facilitate further understanding of the functionality of foramen magnum position during bipedal locomotion.

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Ordinal and Metric Methods for Adult Age Estimation Using Vertebral Osteophytosis

JACOB GRIFFIN

Anthropology, University of North Carolina at Chapel Hill

Historically, the presence and quantity of vertebral osteophytes have been used by forensic anthropologists and bioarchaeologists to indicate whether an adult is young, middle-aged, or elderly. However, to date, the previous methods for adult age estimation using vertebral osteophytosis have not been validated with the same scrutiny as the traditional age estimation methods. This study compared the utility and validity of vertebral osteophytosis using a revised ordinal scoring method and a newly created metric scoring procedure. For the ordinal system, 108 males and 95 females between the ages of 20 and 96 were sampled from the Hamann-Todd Skeletal Collection. First, an ordinal scoring procedure was used to quantify the level of osteophytosis for ten sites on the vertebral centra. Partial least squares regression found an R^2 of 0.50 for combined males and females. Then, 191 males and 170 females were sampled using a metric scoring procedure that quantified osteophytosis on the posterior centrum from nine vertebrae. Stepwise multiple regression and partial least squares regression resulted in R^2 values of 0.46 and 0.367, respectively, for males and 0.53 and 0.551 for females. Overall, the metric system for age estimation using vertebral osteophytosis is an improvement upon the previous ordinal scoring system with stepwise multiple regression showing the highest R^2 values and smallest prediction intervals. In addition, the lower bounds of these prediction intervals provide important cut off points, which can be used in conjunction with other methods to narrow adult age estimates.

Molar microwear and carbon isotope variability of South African australopiths in relation to site paleoecology and taxonomy

FREDERICK E. GRINE[1], JULIA LEE-THORP[2], MATT SPONHEIMER[3], MARK F. TEAFORD[4], PETER S. UNGAR[5] and DEMING YANG[6]

[1]Department of Anthropology, Stony Brook University, [2]School of Archaeology, University of Oxford, [3]Department of Anthropology, University of Colorado Boulder, [4]Department of Basic Science, Touro University, [5]Environmental Dynamics Program and Department of Anthropology, University of Arkansas, [6]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University

Occlusal microwear fabrics and stable light isotopes preserve direct evidence from foods consumed, and thus inform the diets of extinct individuals. We evaluate variation in microwear texture and carbon isotope compositions for *Australopithecus africanus* and *Paranthropus robustus* in relation to paleoenvironmental reconstructions for the repositories from which these fossils derive. Distributions of microwear texture data for 44 *Australopithecus* specimens from Makapansgat (Member 3) and Sterkfontein (Member 4) and 54 *Paranthropus* from Swartkrans (Members 1 "Hanging Remnant," 1 "Lower Bank," 2 and 3) and Kromdraai are compared with isotopic data for 24 *A. africanus* and 22 *P. robustus* from the same deposits. Makapansgat Member 3 is reconstructed as

having witnessed more closed conditions than Sterkfontein Member 4. While the carbon isotope compositions of these samples do not differ significantly from one another, and only two of 16 microwear variables differ significantly between them, the $\delta^{13}C$ and microwear complexity values from Makapansgat tend towards the lower ends of the Sterkfontein ranges. Similarly, Swartkrans Member 1 appears to have been somewhat more open than Swartkrans Member 2; this is not reflected by microwear textures, but the $\delta^{13}C$ values from the latter tend toward the lower side of the Member 1 range. Swartkrans Member 1 "Lower Bank" fossils display a wider range of $\delta^{13}C$ values but a narrower range of microwear complexity values than those from Member 1 "Hanging Remnant." Neither microwear texture nor carbon isotope data serve to differentiate specimens that have been proposed to represent *A. prometheus* from Makapansgat and Sterkfontein.

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Cryptic Communication in a Montane Nocturnal Haplorhine

NANDA B. GROW-BLONG

Department of Sociology, Social Work, and Anthropology, Utah State University

The montane habitat of pygmy tarsiers (*Tarsius pumilus*) may influence their communication behavior. Moss coverage, humidity, and precipitation increase with altitude, all of which impact sound transmission by increasing ambient noise and sound attenuation. Furthermore, montane habitat structure includes a patchier forest canopy of lower height, which may increase the threat of detection by predators. Montane tarsiers are predicted to use more cryptic vocal and chemical communication strategies compared to their lowland counterparts. This study reports on the communication strategies of pygmy tarsiers based on the only known observations of this primate in the mountains of central Sulawesi, Indonesia. Compared to the more detectable lowland tarsiers, highland pygmy tarsiers exhibit communication style that includes a lack of scentmarks and lower frequency vocalizations. Pygmy tarsiers regularly exhibit calls with a dominant frequency of 60-80 kHz, higher than the dominant frequency of pure ultrasonic vocalizations emitted by Philippine tarsiers (*T. syrichta*) and spectral tarsiers (*T. tarsier*), and in association with internal ear morphology that is less attuned to low frequency sounds. These results indicate that highland, smaller-bodied pygmy tarsiers habitually communicate at high frequencies in contexts where lowland tarsiers use lower frequencies, such as when they leave and return to their sleeping sites. I suggest that these traits represent a retention of primitive haplorrhine traits rather than derived adaptations to a montane environment.

Evolution of the *ACE* and *ACTN3* genes in primates

NATALIA T. GRUBE[1] and MICHAEL E. STEIPER[1,2,3,4]

[1]Anthropology, Hunter College CUNY, [2]Program in Human Biology, Hunter College of the City University of New York, [3]Program in Anthropology, The Graduate Center of the City University of New York, [4]NYCEP, New York Consortium in Evolutionary Primatology

The endurance running hypothesis has emerged as a key idea to explain several unique anatomical, physiological, and genetic features of modern humans—among these features is the evolution of *ACTN3* (Bramble & Lieberman 2004, Nature), a gene linked to human athletic performance. An additional gene linked to human endurance performance is *ACE*. Because endurance running is a uniquely human trait, we predicted that the evolution of the *ACE* and *ACTN3* genes would be evolving adaptively in the human lineage when examined in a wider primatogical framework. To test this we compiled *ACE* and *ACTN3* genes from 14 primate species and phylogenetically tested if these genes had a significantly different pattern of selection in the human lineage compared to other primates. We found that the human lineage experienced significantly weaker purifying selection in *ACTN3* when compared to other primate lineages. The human *ACE* gene, on the other hand, was not evolving differently. Thus, these results show that there has been negative purifying selection acting on both genes for all primate species. However, *ACTN3* is evolving differentially in humans than other primates and has a relatively elevated rate of amino acid replacements compared to other primates. Further research is required to study the amino acid replacements found in the human *ACTN3* gene to determine if any play a role in human's enhanced endurance capabilities.

Global or local: Where do we find phylogenetic signal in papionin cranial shape?

NICOLE D.S. GRUNSTRA, SILVESTER J. BARTSCH and PHILIPP MITTEROECKER

Theoretical Biology, University of Vienna

The primate head consists of different functional units, such as the braincase, the orbits, and the jaws, which are adapted to their specific function in the species' ecological environment. Due to these adaptive histories, overall cranial shape does not reliably reflect phylogeny. However, the relative extent to which different cranial bones realize these functional units may have little, if any, adaptive value. For example, we may expect similar overall upper jaw shape in primate lineages with similar nutritional strategies, but the relative sizes of the premaxilla, the maxilla, and the palatine may differ considerably without functional impact. The relative dimensions of the constituting bones may thus carry more phylogenetic signal than the structure's overall shape.

To test this expectation, we conducted a geometric morphometric analysis of 69 midsagittal landmarks taken on CT scans of 20 papionin species, plus one outgroup. Indeed, we found that the shape of the individual cranial bones, considered separately, varies more than overall cranial shape. In other words, the larger the spatial scale, the smaller the shape variation we observe. To explore phylogenetic signal, we considered the shape of the cranial outline separately from the inner landmarks that delineate the different bones, after they were warped to the same outline shape for all species. As expected, the "residual shape" of these inner landmarks, expressing the relative dimensions of the bones, showed a higher correlation with an independent molecular phylogeny than cranial outline shape. We discuss the consequences of these findings for phylogenetic analysis in evolutionary anthropology.

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Patterns of lateral enamel growth in *Homo naledi* as assessed through perikymata distribution and number

DEBBIE GUATELLI-STEINBERG[1], MACKIE O'HARA[1], ADELINE LE CABEC[2], DONALD J. REID[3], LUCAS K. DELEZENE[4], MATTHEW M. SKINNER[5] and LEE R. BERGER[6]

[1]Department of Anthropology, The Ohio State University, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [3]Department of Anthropology, The George Washington University, [4]Department of Anthropology, University of Arkansas, [5]School of Anthropology and Conservation, University of Kent, [6]Evolutionary Studies Institute and the National Centre for Excellence in PalaeoSciences, University of the Witwatersrand

Perikymata, incremental growth layers in tooth crowns, vary in their distribution and number along the lateral enamel surfaces of hominin teeth, although with overlapping ranges. This study asks: (1) How does the distribution of perikymata along the lateral enamel surface of *Homo naledi* anterior teeth compare to that of other hominins? and, (2) When both perikymata distribution and number are analyzed together, how distinct is *H. naledi* from other hominins? Here, 19 *H. naledi* permanentanterior teeth (incisors and canines) are compared (by tooth type) to 294 permanent anterior teeth of other hominins: *Australopithecus afarensis, Australopithecus africanus*, *Paranthropus robustus*, *Paranthropus boisei*, *Homo ergaster/erectus*, and other comparative early *Homo*, with varying sample sizes per taxon/group and tooth type. Repeated measures analyses of the percentage of perikymata per

decile of reconstructed crown height yield statistically significant differences between *H. naledi* and other hominins. Canonical variates analysis of percentage of perikymata in the cervical half of the crown combined with perikymata number reveals that *H. naledi* teeth are correctly classified in 68% of 19 cases, while 2% of the 294 comparative teeth are misclassified as *H. naledi*. What tends to differentiate *H. naledi* anterior tooth crowns from those of most other hominins, including some modern humans, is a combination of strongly skewed perikymata distributions (most perikymata are closely packed into cervical deciles) and perikymata numbers that fall in the middle to lower ranges of hominin values. Implications of these data for the growth and development of *H. naledi* anterior teeth are considered.

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Differences in Bovidae faunal abundance in the Pleistocene of the Omo Group of East Africa

AMANDA GUERRERO[1,10], LAUREN ANDERSON[10,2], KAYLA ALLEN[10,3], KAEDAN P. O'BRIEN[10,4], BRANDON ZELLER[10,3], DEGSEW ZERIHUN[10,5], MARYSE D. BIERNAT[10,5], AMANDA MCGROSKY[10,6], FELIPE S. TORRES[10,7], DAVID B. PATTERSON[10,8], DAVID R. BRAUN[10,9] and JEFFREY SECKINGER[10]

[1]Anthropology, University of La Verne, [2]Anthropology, The George Washington University, [3]Biology, University of North Georgia, [4]Anthropology/Integrated biology, University of Wisconsin-Madison, [5]Authority for Research and Conservation of Cultural Heritage, Addis Ababa, [6]School of Human Evolution and Social Change, Arizona State University, [7]Instituto de Ciencias de la Tierra, Universidad Austral de Chile, [8]Biology, University of North Georgia, [9]Center for Advanced Study of Human Paleobiology, The George Washington University, [10]Koobi Fora Research and Training Program, The George Washington University

The expansion of grasslands in the Turkana Basin of eastern Africa, between 2.0-1.4 Ma, has long been associated with key events in hominin evolution. However, paleoecological drivers behind the behavioral and anatomical changes associated with hominins during this timeframe remain uncertain. We seek to reconstruct the paleoecosystem inhabited by particular hominins to better understand evolutionary pressures on these species. We hypothesize that arid environments began to dominate the Nachukui and Koobi Fora Formations of the Omo Group around 2.0 Ma. In particular we are interested in potential aridity associated with the regression of Lorenyang Lake, around 2.0 Ma. Bovids that were adapted to mesic habitats sought refuge in the, Shungura Formation at this time. We evaluated the faunal abundance of Bovidae tribes from the Omo Group. Our dataset was composed of existing datasets and materials collected during our 2017 field season (n > 5,000). Differences in bovid abundance show significant differences between the different Formations of the Lower Omo Valley (i.e. Koobi Fora, Nachukui and Shungura). All areas of the Turkana Basin were dominated by bovids indicating mesic habitats between 2.0 and 1.87 Ma. In subsequent time periods (1.87-1.48 Ma) these species become relatively more abundant in the Shungura Fm. Later in time the entire basin shows a greater mixture of species that are adapted to xeric and mesic environments indicating greater heterogeneity. The abundances of bovid taxa provide a crucial understanding of the context of major changes in the hominin lineage in the Plio-Pleistocene.

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Evolutionary genomics of Verreaux's sifaka *(Propithecus verreauxi*)

ELAINE E. GUEVARA[1,2], TIMOTHY H. WEBSTER[3], JEANNIN RANAIVONASY[4], JOELISOA RATSIRARSON[4], RICHARD R. LAWLER[5], BRENDA J. BRADLEY[2], R. ALAN. HARRIS[6], YUE LIU[6], S. C. MURALI[6], M. RAVEENDRAN[6], DANIEL ST. HUGHES[6], DONNA M. MUZNY[6], ANNE D. YODER[7], KIM C. WORLEY[6] and JEFFREY ROGERS[5]

[1]Anthropology, Yale University, [2]Anthropology, The George Washington University, [3]School of Life Sciences, Arizona State University, [4]Département des Eaux et Forêts, University of Antananarivo, [5]Department of Sociology and Anthropology, James Madison University, [6]Human Genome Sequencing Center, Baylor College of Medicine, [7]Duke Lemur Center, Duke University

We undertook high-coverage resequencing of the genome of a male Verreaux's sifaka (*Propithecus verreauxi*) from Bezà Mahafaly Special Reserve (BMSR) in southwestern Madagascar to aid ongoing research on this species and further knowledge of sifaka biology. Here we report on the results of comparative analyses of coding regions. We mapped sequence reads to the recently *de novo* assembled and annotated genome of the closely-related Coquerel's sifaka (*Propithecus coquereli*), after which we performed variant calling within regions of sufficient coverage and mapping quality. We annotated quality filtered variants with functional information. We then identified genes containing high-impact variants or an elevated number of moderate-impact variants for gene ontology classification. In parallel, because Verreaux's sifakas at BMSR, like humans, are remarkably long-lived for their body size, we examined 395 longevity-associated candidate genes in the sifaka genome. Specifically, we assembled Verreaux's sifaka coding sequences and aligned them to MultiZ placental mammal canonical coding sequence alignments for comparative genomic analysis. We then estimated a gene tree for each resulting alignment, which was used to calculate dN/dS and test for evidence of positive selection along the Verreaux's sifaka, ancestral sifaka, and ancestral lemur branches. We discovered evidence of potentially functional sequence divergence in genes involved in genome maintenance and metabolism. Notably, these include several genes previously identified as showing accelerated evolution in other long-lived mammalian lineages. Our results thus indicate potential convergence within pathways, and possibly even particular genes, influencing intrinsic longevity potential, which could shed light on primate life history evolution.

The costs of mating for female chimpanzees at Ngogo, Kibale National Park, Uganda

SHOLLY GUNTER[1,2] and JANINE L. BROWN[3]

[1]Biology, McLennan Community College, [2]Anthropology, Yale University, [3]Center for Species Survival, Smithsonian Conservation Biology Institute

During estrus, female chimpanzees develop exaggerated sexual swellings and mate promiscuously. Previous studies have shown that as estrus progresses, parous females in particular attract increasingly more males, mate more, and are subjected to increased male aggression. We hypothesized that as male interest and aggression increase in conjunction with cycle stage, females suffer the costs of altered activity budgets and elevated stress levels, with parous females most affected. We investigated this by using generalized linear mixed models to compare females' experiences when not sexually receptive (NS), sexually receptive/non-ovulatory (non-POP), and sexually receptive/ovulatory (POP). Our analyses showed that the number of males in the party ($F(2, 158) = 15.2$, $p < 0.01$), mating rates ($F(2, 158) = 96.4$, $p < 0.01$), and male aggression rates ($F(2, 158) = 12.2$, $p < 0.01$) increased at each stage of the reproductive cycle and were consistently higher for parous females. All females suffered losses in foraging opportunity and increases in stress as a result of mating. During POP females experienced a reduction in feeding time ($F(2, 154) = 5.7$, $p < 0.01$) and diet quality ($F(2, 153) = 3.4$, $p < 0.05$), an increase in time spent idle ($F(2, 155) = 5.1$, $p < 0.01$), and elevated cortisol levels ($F(2, 117) = 7.8$, $p < 0.01$). Our study supports previous findings highlighting the effect of parity and cycle stage on female attractiveness. These results also suggest females incur energetic and physiological costs as a result of promiscuous mating, primarily during the ovulatory period.

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Echolocation in a Nocturnal Primate?

SHARON GURSKY and CODY MOSER.

Anthropology, Texas A&M University

It is well known that many non-primate mammals emit vocalizations beyond the range of human hearing. Studies of ultrasonic vocalizations in the nonhuman primates are much more limited. Recently, it was noted that Gursky's Spectral Tarsier emits ultrasonic calls. This paper explores one possible function of these ultrasonic vocalizations, that of echolocation. If the tarsiers use ultrasonic vocalizations for echolocation, then it is predicted that the ultrasonic vocalizations will only be emitted during locomotion, or only certain ultrasonic calls will be emitted during locomotion. This research was conducted at Tangkoko Nature Reserve in Sulawesi, Indonesia May-August 2017. During focal follows each individual's behavior (n=4) was recorded using continuous focal follows. All ultrasonic vocalizations emitted by the focal individual were simultaneously recorded using a Song Meter BAT2. During approximately 144 hours of observation the tarsiers emitted a total of 619 ultrasonic vocalizations, involving six different types of ultrasonic calls. 257 ultrasonic calls were recorded when the tarsiers were engaged in locomotor behavior. Significantly more ultrasonic calls were given during locomotor activity than while engaged in other behaviors. Only two of the previously five known ultrasonic calls given by spectral tarsiers were emitted during these locomotor bouts: whistles and doubles. Both of these represent pure ultrasonic calls. A sixth, and previously unknown ultrasonic call, the frequency modulated (FM) call, was never emitted during any behavioral activity besides locomotion. This suggests that it might be used for navigation. Additional research is needed to ascertain whether these vocalizations are used to navigate.

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Validation of a multi-sensor, high-speed IMU-based motion measurement system

MARISOL GUZMAN[1], OSHANE O. THOMAS[2], ALLYSON JULIAN[2], MARIA FOX[2] and JOHN D. POLK[2,3]

[1]Engineering, Harvey Mudd College, [2]Anthropology, University of Illinois Urbana-Champaign, [3]Biomedical Sciences and Engineering, University of Illinois Urbana-Champaign

Quantitative analyses of primate movement have traditionally relied on video or optical motion-capture systems that measure movement in spatially-constrained calibrated spaces over short durations. Advances in sensor and processor miniaturization have allowed a proliferation of inertial sensor systems for recording motion data over longer periods of time, but most frequently, these are limited to single or few sensors and may collect data at rates that are too slow to monitor normal or high-speed movements in humans or other primates. Here we present the validation for a wearable, multi-sensor high-speed IMU sensor system for gait analysis.

The system consists of four independent sensors each consisting of a triaxial accelerometer, rate gyro and magnetometer connected to an Intel Edison processor. The system can record motion at up to 260Hz. IMU accuracy depends upon calibration method and the ways in which sensor information is combined (fusion). We compare two calibration (Max/Min, Offline Ellipsoid-Fit) and two fusion techniques (Madgwick and Kalman Filter) determine which techniques provide more accurate reconstruction of human lower limb angular kinematics. IMU data are compared to a 6-camera Qualisys motion-capture system. Comparisons were quantified using root-mean-square difference methods.

Our results demonstrate that the Offline Ellipsoid-Fit calibration and Kalman Filter fusion methods provide increased accuracy, and suggest that human lower limb kinematics can be accurately reconstructed using this IMU system. This system will enable long-term measurement of postural and performance data in a range of species and environmental conditions.

This research is supported by National Science Foundation grant #BCS-1638756; University of Illinois Research Board; University of Illinois Summer Research Opportunities Program.

A juvenile hominin ischium from the Pliocene of Woranso-Mille (central Afar, Ethiopia)

YOHANNES HAILE-SELASSIE

Physical Anthropology, The Cleveland Museum of Natural History

Hominin pelvic elements, despite their significance in our understanding of locomotor adaptation and obstetrics, are extremely rare in the Pliocene fossil hominin record, particularly prior to 2 Ma. Here, I describe an almost complete ischium (BRT-VP-2/87) of a juvenile hominin, from ca. 3.4-3.3 Ma deposits of the Woranso-Mille, Afar region, Ethiopia. The specimen was found from the same locality and horizon as the Burtele partial foot. BRT-VP-2/87 is a right ischium morphologically similar to equally juvenile, and/or slightly older, ischia from Hadar and Makapansgat. The similarities include the superior edge of the ischial tuberosity being lower than the inferior end of the lunate surface of the acetabulum and the tuberoacetabular sulcus being relatively wide. These morphological traits also characterize fully adult *Australopithecus/Paranthropus* ischia. In the species of *Homo*, the tuberoacetabular sulcus is narrow and the superior terminus of the ischial tuberosity is positioned more superiorly relative to the inferior edge of lunate surface of the acetabulum. Few metric measurements also indicate that as in adult *Australopithecus* ischia, BRT-VP-2/87 has longer ischial body, relative to the diameter of the acetabulum. Preliminary morphological and metric analyses clearly indicate that the adult ischial morphology in pre-*Homo* species is established early in development. Elongated ischial body is also seen in *Ardipithecus ramidus*, indicating that it is probably a primitive retention from an ape-like ancestor. Although its relevance to locomotor adaptation and/or obstetrics is currently unknown, relative reduction in the length of the ischial body is a derived trait only seen in the genus *Homo*.

Field and laboratory research was funded by the National Science Foundation (BCS-1124705) and the Cleveland Museum of Natural History.

Comparing the size of thalamic nuclei in primate brains relative to other mammalian clades

ANDREW C. HALLEY[1], MARY KL. BALDWIN[1], S MURRAY SHERMAN[2] and LEAH KRUBITZER[1,3]

[1]Center for Neuroscience, University of California, Davis, [2]Department of Neurobiology, University of Chicago, [3]Department of Psychology, University of California, Davis

Primates exhibit exceptionally large neocortices across a wide range of absolute brain size when compared to other mammals. This expansion has been accompanied by an increase in the number of distinct cortical areas. The functions of cortical areas rely on their connections with the thalamus, which provides input to the neocortex from the sensory periphery and relays information between different cortical areas. While nuclei associated with visual processing in the primate thalamus (e.g. lateral geniculate nucleus, pulvinar) have been studied extensively, less is known about the scaling of other first-order sensory nuclei in the primates outside of apes, or in other mammalian clades. In this study, we measured the size of both "primary" first-order sensory nuclei (e.g. LGN, ventral posterior, medial geniculate) and higher-order nuclei (e.g. pulvinar; medial dorsal) in a comparative sample of primates, carnivores, rodents, and other mammals. 3D reconstructions were generated to characterize the organization of thalamic nuclei in each species, and volumes were measured from serial coronal sections processed for cytochrome oxidase, Nissl, AChE, VGLUT2, and/or myelin. Allometric analyses indicate that thalamic nuclei scale at different rates as the absolute size of the thalamus increases, with evidence for both positive allometry (e.g. MD) as well as negative allometry (e.g. LGN, VP). We compare our results with previous findings on thalamic allometry, describe the size of first-order nuclei relative to data on the size of corresponding primary cortical fields in primates,

and discuss these findings within the context of major theories of brain area scaling.

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Acts of violence, acts of caring. On human remains with traces of non-lethal violence at the hunter-gatherer site Kanaljorden, Motala, Sweden c. 7700-7600 cal BP

FREDRIK HALLGREN[1], SARA GUMMESSON[2] and ANNA KJELLSTRÖM[2]

[1]Archaeology, The Cultural Heritage Foundation, [2]Osteoarchaeological Research Laboratory, Stockholm University

Excavations at Kanaljorden, Motala, Sweden has unearthed a complex mortuary context from the Mesolithic, c. 7700-7600 cal BP. Disarticulated human remains, mostly crania, from a dozen individuals were found deposited on a stone-packing built on the bottom of a small lake. The human remains were laid down with artefacts of bone, antler and stone as well as different parts of animals. The majority of the human crania display healed blunt force trauma. After death, the bodies were disarticulated, selected parts were chosen for inclusion in the ritual. Two of the crania were recovered still mounted on wooden stakes, others were broken apart and deposited inside or next to still other skulls. The high indices of *healed* head trauma indicate that the individuals chosen for inclusion in the ritual experienced both violence *and* care giving during their life. In death, their bodies were disarticulated, put on display and in some cases their crania were intentionally broken, acts that could be understood either as violence or as mourning and reverence. We suggest that the violence experienced in life and the complex treatment in death, should be understood not only in terms of individual victims, perpetrators and next of kin, but could also be discussed in terms of cultural practices involving collectives of actors. While their actions to a degree may have been structured by and played out within a framework of a pre-existing social order, their acts may also have served to manipulate and change this order.

Understanding Resilience in Chimpanzees (*Pan troglodytes*): Case studies from the wild and from captivity

ANDREW R. HALLORAN

Chimpanzee Care, Save The Chimps, Research, Conservation Society of Sierra Leone

Resilience has been defined as "the process of adapting well in the face of adversity, trauma, tragedy, threats or even significant sources of threat" (APA 2010). Chimpanzees have been shown an ability to adapt to sub-par circumstances and histories, both in the wild (Hockings et al. 2015) and in captivity (Llorente et al. 2015). It is important to our understanding of chimpanzee ecology, to explore how chimpanzees are adapting to these circumstances and it may be useful to view this phenomena in terms of resilience. However, up to now, studies on adaptations to adversity have centered solely on either captive chimpanzees or wild chimpanzees; with little attempt to synthesize the individual adaptations in captivity with the plasticity of wild chimpanzees in ecologically imperiled areas. To initiate this exploration, case studies are presented within the contexts of captive chimpanzees, now living in complex social groups at a sanctuary, overcoming histories of isolation and trauma; alongside case studies of two communities of wild chimpanzees in an ever changing mosaic of fallow forest and farms that are maintaining a population density that would seem to be out-populating the perceived carrying capacity of the habitat. These case studies can shed light on whether or not the flexibility of previously isolated and traumatized chimpanzees who are now successfully living in complex social groups social is connected to that of chimpanzees successfully adapting to a constant alteration of a dwindling habitat; and in turn, whether this flexibility can be viewed through the lens of resilience.

Strontium Isotopes as Indicators of Philopatric Dispersal Patterns

MARIAN I. HAMILTON and SHERRY NELSON

Anthropology, University of New Mexico

Strontium isotope ratios are frequently used to track faunal movement because plants derived their isotopic signatures from the bedrock on which they grow. Animals incorporate the ratios of the plants or prey they ingest into their own tissues. Therefore faunal tissue isotopic ratios vary based on the bedrock(s) over which the animal moved during the tissue's formation. Previous work has compared tooth enamel strontium isotopes to those from local environments to draw conclusions about sex biases in hominid philopatric dispersal patterns; however, many assumptions underlying these studies have never been tested. The current study presents data from living primates in Kibale National Park, a rainforest in southwestern Uganda, with three major goals: 1) to propose a more biologically meaningful protocol for delineating isotopic boundaries across past and present landscapes; 2) evaluate the efficacy of three different methodological approaches for identifying sex biases in primate philopatric patterns; 3) make recommendations for applying these methods to fossil data. Cluster analysis is the most efficient method to identify isotopically similar areas on a landscape. Faunal home range size relative to the size of these isotopic clusters strongly influences which methods accurately identify dispersing individuals. Such factors must be taken into consideration when applying these methods to the fossil record. This first strontium isotope study in an extant ecosystem provides a foundation from which we can more accurately interpret future fossil data.

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A novel protocol for measurement of vertical ground reaction forces during walking in non-laboratory conditions

ALEXANDRA G. HAMMERBERG, STEVEN LAUTZENHEISER and PATRICIA A. KRAMER

Biocultural Anthropology, University of Washington

Measuring ground reaction forces (GRFs) in bipedal walkers in everyday situations has been challenging, but recent developments in insole sensing technology offer opportunities to explore differences in GRFs across conditions. We hypothesized that maximum vertical GRFs would not differ between treadmill and over-ground walking and that they would be higher in stair walking than on inclines or declines.

Subjects walked in nine conditions: at self-selected slow, normal, and fast velocities on a level treadmill; and at normal velocity on a 10% treadmill incline; an indoor hallway; walk up and down stairs; and outdoors uphill and downhill on a sidewalk in dry conditions. Pressure and total GRF data were gathered at a 50 Hz sampling rate from thirteen in-sole sensors providing localized pressure readings across the footbed every 0.02 seconds. 2653 steps were analyzed.

Treadmill walking showed more variation in center of pressure location than over-ground walking, but the maximum vertical ground reaction forces for treadmill walking were not significantly different than the maximum vertical ground reaction forces during hallway walking ($p=0.410$). The maximum vertical GRFs walking up and down stairs were not significantly different from each other nor from downhill walking ($p's>0.23$). The maximum vertical GRF for walking uphill is 85% of the vertical GRF of stair or downhill walking.

These initial data demonstrate significant differences in maximum vertical GRFs between disparate walking environments, which is a vital step for furthering a more complete understanding of human bipedal biomechanics in everyday conditions.

Morphology and context of a new early *Homo* mandible from Koobi Fora, Kenya

ASHLEY S. HAMMOND[1,2], LAURA E. HUNTER[3], BENJAMIN THOMPSON[4], ELEANOR CORDINER[1], MARYSE BIERNAT[5], W. ANDREW BARR[1] and DAVID R. BRAUN[1,6]

[1]Center for Advanced Study of Human Paleobiology

and the Department of Anthropology, The George Washington University, [2]Human Origins Program, Smithsonian Institution, [3]Ecology, Evolution, and Environmental Biology, Columbia University, [4]Applied Forensic Sciences, Mercyhurst University, [5]School of Human Evolution and Social Change, Arizona State University, [6]Human Evolution, Max Planck Institute for Evolutionary Anthropology

The mandible has played a prominent role in attempts to establish the number of Early Pleistocene *Homo* species represented at Koobi Fora, Kenya. During the 2016 field season of the Koobi Fora Field School, a new hominin partial mandible (KNM-ER 70046) was recovered in Area 123, providing the opportunity to assess taxonomic and morphological diversity in early *Homo*. KNM-ER 70046 was qualitatively and quantitatively compared to other fossils from the Plio-Pleistocene, and the taphonomic and geologic context were characterized. The relative corpus height, width, and molar proportions of KNM-ER 70046 are consistent with early *Homo,* although the postincisive planum is qualitatively inconsistent with specimens sometimes referred to *Homo rudolfensis* (KNM-ER 60000, KNM-ER 1482). Absolute values and most mandibular and dental proportions of KNM-ER 70046 are inconsistent with robust *Australopithecus*. Our assessment finds KNM-ER 70046 to be most similar to *Homo habilis* mandibles (KNM-ER 1501, KNM-ER 1502, OH 13). KNM-ER 70046 was found between the KNM-ER 1813 and KNM-ER 1502 sites in the Upper Burgi member (~1.87-2 Ma). The sediments are similar to the subaerial to lacustrine deposits at the KNM-ER 1502 and KNM-ER 1812 mandible sites, and a high proportion (~80% of sieve fragments) of identifiable fauna were aquatic. The sedimentary context of the KNM-ER 70046 specimen lacks the characteristic $CaCO_3$ nodules that are ubiquitous at the KNM-ER 1813 cranium site, which suggests that KNM-ER 70046 and KNM-ER 1813 represent separate individuals. The morphology, age, and context of KNM-ER 70046 add to our understanding of early *Homo* at Koobi Fora.

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Situating anthropological genetics within local beliefs in pastoral Kenya

CARLA HANDLEY[1], SARAH MATHEW[1], ANGELA TARAVELLA[2], ANNE STONE[1] and MELISSA SAYRES-WILSON[2]

[1]School of Human Evolution and Social Change, Arizona State University, [2]School of Life Sciences, Arizona State University

A number of recent publications, such as 2014's *Guidelines for genomics work on vulnerable populations* (H3Africa) and the 2017 *San Code of Ethics*, highlight comprehensive and culturally sensitive research practices aimed at improving local community inclusion. These formal documents represent a growing recognition that researchers should integrate local participants throughout the scientific process - from proposal conception, to methodological design, data collection, publication, and educational / knowledge feedback into the community. These are commendable and concrete steps to improve local autonomy and encourage reflection by scientists on best research practices that are culturally acceptable and relevant to study participants.

In 2016 – 2017 we conducted a study measuring genetic variation among the Turkana, Borana, Rendille, and Samburu pastoral ethnic groups of northern Kenya, involving collection of mouth swabs and saliva samples. Methodologies were designed to avoid transgressions against cultural taboos and explicitly required results feedback to participants, that they may find to be educationally, culturally, and socially beneficial. Dissemination materials reflected local languages and engaged participants through readily familiar concepts. This feedback integration allows for communities to be active participants in how research findings are disseminated and culturally-framed, thus helping to maintain and build trust between scientific and local communities.

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Life in the Pre-Contact Cibola Region: Osteobiographies of Human Remains from Chaco Outlier Sites

ASHLEY A. HANNIGAN

Anthropology, University of Alaska Anchorage

Research on human skeletal remains associated with Ancestral Puebloan sites in the Southwestern United States during the late Pueblo I and Pueblo II periods is often focused on larger sites such as Chaco Canyon. Outlier sites, however, are often overlooked. Examples are Village of the Great Kivas and sites in the Red Mesa Valley, both of which are situated within the Cibola Region. This region has many of the same features that are seen within other portions of the Chaco Phenomenon, but some researchers consider it culturally distinct based on artifact types. Examination of human skeletal remains from these outlier sites focused both on the individual and population level to understand life in these communities. The goal was to reconstruct identity, and identify indicators of stress, and the presence of trauma in the context and evidence of regional interaction. A total of 12 individuals from Village of the Great Kivas and 18 individuals from Red Mesa Valley were analyzed, and osteobiographies were created for each individual. Comparisons were made between the people inhabiting each area, controlling for age and sex. The results indicate that there were differential rates of health and disease and fatal and non-fatal trauma. These patterns were compared to prior research conducted at other sites in the Chaco Phenomenon. In addition to more general patterns found between the communities and among other communities in the region, the osteobiographies revealed something unique about each individual, and brought to light their identities, and provided insight into their lived experiences.

Travel assistance to collect data was obtained by the Karen and William B. Workman Travel Grant, UAA Department of Anthropology.

Classification of fractures in human ribs subjected to dynamic bending

ANGELA L. HARDEN[1] and AMANDA M. AGNEW[1,2]

[1]Skeletal Biology Research Laboratory, The Ohio State University, [2]Department of Anthropology, The Ohio State University

Several fracture classification systems are used throughout forensic, anthropology, and clinical communities; however, none are dedicated specifically to rib fractures. Additionally, many current classification systems use loading/failure mechanism to identify fracture type when mechanism has not or cannot be reliably determined. In order to verify the appropriateness of this approach an independent system for characterization of rib fractures must be established.

Sixty-eight mid-level (4–8) male and female human ribs were subjected to dynamic bending in the antero-posterior direction. The AO/OTA fracture classification system was applied and also included fracture location (%). Each fracture was classified using a two-part system with three initial types of fracture classifications (simple, wedge, or complex) and for each classification there were three different groups (e.g., simple transverse, wedge oblique, or complex segmental).

Fracture locations ranged from 20–96% (mean = 65%) of the total rib length, and six different fracture types were observed. Forty percent of fractures were classified as A3 fractures (simple transverse), 31% were B2 fractures (wedge oblique), followed by 16% as A2 (simple oblique), 7% as C3 (complex irregular), 4% as C2 (complex segmental), and 1% as B3 (wedge multifragmentary). No trend was found for fracture classifications regarding rib level or fracture location. These findings demonstrate that when human ribs are subjected to identical loading in bending, multiple fracture types can be observed, indicating accurate prediction of fracture classification based on mechanism may not be possible. Future research is required to validate whether other loading mechanisms result in specific fracture types.

Genetic correlations in the canine-premolar honing complex of the rhesus macaques of Cayo Santiago

ANNA M. HARDIN

Department of Anthropology, University of Minnesota

Functional coordination in the maxillary and mandibular canines and mesial mandibular premolar in the anthropoid canine-premolar honing complex indicates that the dimensions of these teeth covary genetically or developmentally. Understanding the exact nature of this covariance will inform hypotheses related to the evolution of the canine-premolar honing complex in anthropoids and its reduction in the hominin lineage. Using dental measurements and maternal identities from the Cayo Santiago rhesus macaque (*Macaca mulatta*) population, genetic correlations between dimensions of teeth within the honing complex were estimated. More than half of the genetic correlation estimates are significantly greater than zero, and genetic correlations are greatest between, rather than within, teeth. Additional genetic correlation estimates between dimensions of the honing complex and measurements from the incisors, premolars, and molars are not consistent with the hypothesis that the honing complex is genetically independent from the surrounding dental structures. The results demonstrate instead that tooth dimensions within the honing complex are genetically correlated with teeth of all types across the tooth row, and support the hypothesis that selection pressures on incisor, premolar or molar size could impact the size and morphology of the canine-premolar honing complex in some anthropoid primates through correlated response to selection. Continued collection of parental identities and skeletal remains from the Cayo Santiago macaques will increase the power with which quantitative genetic parameters can be estimated, which will be necessary to test hypotheses related to sex differences in the genetic architecture of the honing complex.

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Do bonobo (*Pan paniscus*) brains develop to break the sexual dimorphism mold?

BRIAN HARE

Evolutionary Anthropology, Duke University

The self-domestication hypothesis (SDH) proposes that bonobos evolved due to selection against forms of male aggression that altered brain development and resulted in a cascade of phenotypic by-products. Experimental and natural observations suggest that bonobos are more prosocial and less aggressive toward strangers and do not exhibit forms of lethal aggression and female coercion observed in chimpanzees. The SDH is further supported by quantitative comparisons of bonobo and chimpanzee behavior and cognition showing expanded developmental windows in bonobos. In my poster I will reconcile these recent observations with the fact that bonobos and chimpanzees are typically characterized as being similar in sexual dimorphism based on comparisons of body mass. I will review our research that suggests selection against aggression in male bonobos has indeed led to reduced dimorphism in a range of traits including 2D:4D finger ratios, canine teeth, brain size, and spatial cognition. This pattern raises the possibility that sexually dimorphic brain development is another powerful measure of male competition. It also challenges the notion that a shift toward monomorphism in body size is the best or only indicator of high tolerance, xenophilia and prosociality. The question then becomes whether analogous changes in brain development are responsible for the increasing evidence of tolerance and interdependence we observe late in our own species evolution.

Long bone structural proportions and locomotion in cercopithecoids

CHRISTINE M. HARPER[1], DEANNA M. GOLDSTEIN[1], W. SCOTT MCGRAW[2], DAVID J. DAEGLING[3] and CHRISTOPHER B. RUFF[1]

[1]Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [2]Department of Anthropology, The Ohio State University, [3]Department of Anthropology, University of Florida

Locomotor behavior and long bone structural proportions have been shown to be related in broad comparisons across catarrhines and within gorillas and chimpanzees; however, comparisons within cercopithecoids have been limited. Cercopithecoids are primarily quadrupedal, but vary in body size and climbing and leaping frequencies. Here we analyzed long bone structural properties of 14 cercopithecoid species (n=183), including new data from 7 Tai Forest, Ivory Coast species and previous data for 5 African and 2 Asian species. Cross-sectional diaphyseal properties were derived using pQCT (Tai specimens) and medical CT scanning for the major long bones in the mid-diaphysis. Cortical and trabecular bone densities were also measured using pQCT in the Tai specimens in the diaphysis and distal epiphysis, respectively. Articular breadth and depth measurements were used to estimate articular surface areas. Locomotor behavioral data were obtained from the literature. Across 14 species, leaping and hindlimb/forelimb strength were highly correlated ($r=0.895$, $p<0.001$). Climbing and relative articular surface area (articular/diaphyseal proportions) were only weakly associated, with the humerus near-significant ($r=0.567$, $p=0.055$) and the femur non-significant ($r=0.492$, $p=0.104$). There were no significant correlations between behavior and either trabecular or cortical bone density proportions. We interpret the strong association between diaphyseal strength proportions and locomotor behavior to reflect, at least in part, developmental plasticity in cross-sectional geometry of the diaphysis. Articular surface area appears to be more phylogenetically constrained. Bone densities do not vary systematically among taxa. With regard to locomotor effects, overall trabecular density may not be as informative as specific trabecular structural characteristics.

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Metabolic effects of increasing neuronal density in Euarchontoglires

ARIANNA R. HARRINGTON and DOUG M. BOYER

Evolutionary Anthropology, Duke University

Enhanced cognition is widely regarded as having a strong adaptive value and is believed to be mediated by increased brain size and/or neuron numbers. Both factors are also thought to raise metabolic costs of the brain, presenting potential evolutionary limits on cognitive advancement. Euarchonta (primates, scandentians, and dermopterans) are sister taxon with Glires (rodents and lagomorphs). Primates and scandentians have been characterized as having more neurons in a brain of given size than many gliroids, and are predicted to have more metabolically expensive brains. We tested that prediction by examining the scaling of encephalic arterial canal cross sectional area (CCSA) with endocranial volume (ECV). The encephalic arteries are those supplying the brain, and include the vertebral and carotid arteries in many mammals. Mechanistically, CCSA should relate to the volume of blood that can flow through encephalic arteries to deliver metabolic substrates to the brain. Previous research showed that within Euarchonta, CCSA is strongly correlated to ECV and direct measures of whole brain metabolic rates. If gliroid CCSA primarily relates to ECV, they are predicted to have smaller CCSA for a given ECV if their lower neuronal density makes their brains less metabolically expensive. Using a sample of 107 gliroid species, we found that ECV was the strongest correlate of CCSA, as it is in Euarchonta. However, gliroids do not have smaller CCSAs for their ECV than euarchontans. These results suggest that greater neuronal density in euarchontans has not lead to correspondingly higher tissue specific blood requirements and metabolic rates.

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Modelling Appositional Long Bone Growth in Non-Sedentary Children: Implications for Cross-Sectional Geometry

LESLEY HARRINGTON[1], HELEN K. KURKI[2], BENJAMIN OSIPOV[1], MARLA MACKINNON[2] and LIBBY W. COWGILL[3]

[1]Department of Anthropology, University of Alberta, [2]Department of Anthropology, University of Victoria, [3]Department of Anthropology, University of Missouri

Cross-sectional geometry (CSG) is a widely employed approach used to examine the skeletal signature of habitual physical activity patterns among past populations. When robusticity is interrogated from an ontogenetic perspective, additional insights about subsistence strategies can be made by examining the tempo of cortical bone apposition in relation to dental age at death in archaeological child burials. CSG properties at midshaft femur and humerus were analysed in subadult skeletons comprising non-sedentary Holocene populations (Indian Knoll n =34; Later Stone Age n=82; Point Hope n=20.) Here we examine the question of what significance the endosteal contour has in modelling bone strength over the course of growth by evaluating agreement among properties derived from methods which variously estimate cross-sectional shape. Using the Latex Cast Method (LCM) as the standard for comparison, we find that modeling techniques that are relaxed by estimating both the periosteal and endosteal contours (EEM), or omitting the endosteal contour altogether (SSM), perform equally well throughout development. Residuals from the regressions of relaxed methods on LCM were not associated with estimated age. Not all properties are equally well-estimated by the more relaxed models, as expected, but also there are differences between the populations, with Later Stone Age robusticity being overestimated by EEM and SSM more so than for Indian Knoll and Point Hope.

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Tool use in tufted capuchin monkeys (*Sapajus libidinosus*) promotes persistent foraging behavior

BRENDAN D. HARRIS[1], CAROLINE E. JONES[1], MACKENZIE R. PRYOR[2] and DOROTHY M. FRAGASZY[1]

[1]Department of Psychology, University of Georgia, [2]Warnell School of Forestry, University of Georgia

Tufted capuchin monkeys (*Sapajus libidinosus*) are generalist omnivores, and the only New World primate to habitually use tools. Capuchins have been described as persistent in nature and motivated to practice nut-cracking using stone tools. Due to the lack of a baseline measurement, or even a definition of persistence, the term has rarely been studied as a feature of animal behavior. The goal of this research is to examine persistence as it applies to tool-use in a group of wild tufted capuchin monkeys at Fazenda Boa Vista, Brazil. We hypothesized that working with a tool would promote the development of sustained attention, and result in more persistent foraging behavior than foraging without a tool. A total of 24 extractive foraging bouts by 12 monkeys were video recorded from May to July 2015. Foraging bouts were coded, and duration and behavioral variation were compared in tool versus non-tool food bouts, and percussive versus non-percussive food bouts. Our results support our hypothesis that working with a tool results in significantly more persistent foraging behavior ($p<0.05$): the monkeys spent, on average, 50% more time foraging when the food bout required a tool; they also spent, on average, 167% more time foraging when the food bout was percussive. This finding is indicative of tools acting as motivators to persist in goal-directed tasks in non-human primates, which may point to this feature of behavior as an important factor in the evolution of tool-use.

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Shared signals of selection between populations is not due to shared ancestry alone

NATHAN S. HARRIS

Department of Anthropology, University of Utah

Moderate signals of selection in the genome are often overlooked because they provide little information about major targets of selection. However, these signals are well suited to comparing similarities in evolutionary history between populations. To investigate these signals we calculated three selection statistics across all 1000 genomes phase 3 populations, and calculated the covariance for each pair of populations for each analysis. Covariance values will depend on degree of shared ancestry, a relationship that has not been investigated in the literature. Furthermore, we can observe this effect at different timescales because of the varying sensitivity of the selection scans. Here we show that some pairs of populations deviate from the relationship between shared ancestry and shared signals of selection. Continental groups shared more signals between pairs than expected due to ancestry, with the exception of Africa, which shared fewer signals. Curiously, Southern Asian populations shared fewer signals with Europeans than expected but the opposite pattern was found between Eastern Asians and Europeans. We suggest that population pairs with an excess of shared selective signals likely experienced weak selection for variants inherited from their common ancestor. When two populations share fewer signals than expected, weak selection is likely working on different ancestral variations, or population specific derived alleles, reflecting a response to unique local conditions.

Cancer across primates: a life history perspective on disease susceptibility

VALERIE K. HARRIS[1], WILLIAM C. WALKER[1], ASHLEY ZEHNDER[2], MICHAEL GARNER[3], CARLO C. MALEY[1,4] and AMY BODDY[5]

[1]Center for Personalized Diagnostics, Arizona State University, [2]Biomedical Data Science, Stanford University, [3]Northwest ZooPath, Monroe, Washington, [4]School of Life Science, Arizona State University, [5]Department of Anthropology, University of California, Santa Barbara

Cancer continues to be one of the leading causes of mortality among human populations, yet we know little on how disease susceptibility varies compared to nonhuman primates. While tumors have been infrequently reported in nonhuman primates, past reports suggest nonhuman primates, including great apes, get much less cancer than humans. Here we report the incidence of cancer from 2,352 individuals across 40 species, representing 10 different Primate families from over 23 years of histopathology and necropsy reports from zoos, wildlife sanctuaries and veterinary facilities. In our survey, we have found that the overall rate of cancer incidence in Primates is ~18%. Our data suggests nonhuman primates and humans share similar cancer incidence rates. However, we find there is diversity of incidence rates per family, ranging from 53% in Cheirogaleidae (dwarf and mouse lemurs), to 8% in Hylobatidae (gibbons). We suggest a life history theory framework can help elucidate this variation in observed in cancer rates across primates, where long-lived, large-bodied animals invest more energy in somatic maintenance (i.e. cancer defenses) to maintain their cellular body. We then test for an association between cancer incidence and life history traits, including body mass, lifespan, metabolic rate, and age to sexual maturity. Our data indicates that larger, long-lived primates, such as great apes, have increased cancer defense mechanisms compared to smaller, shorter lived primates, such as lemurs and lorises. Lastly, we discuss how reproductive competition, such as sexual dimorphism, may pose trade-offs between optimal cancer suppression among some species of primates.

Uncertain Weather, Unpredictable People: A bioarchaeological assessment of how humans react to climate change

RYAN P. HARROD

Anthropology, University of Alaska Anchorage

Humans have cultural innovations and biological adaptations as tools to buffer against fluctuations in their environment. Our species has reproduced at an astonishing rate, occupied nearly every part of the planet, and survived multiple global

climate events. Environmental change, especially prolonged periods of instability, affect how well we can weather the storm. Despite some recent controversial claims, another global climate change event is happening, so the need to understand how people adapted, or failed to adapt, to changing climate is critical. Looking to the past can provide insight for how we can proactively respond today. Bioarchaeological analysis of human skeletal remains provides a way to assess how group size, subsistence strategy, sociopolitical organization, and regional integration contribute to how different groups react to global and regional climate events. Analysis included original and published research on remains dated to the Medieval Warm Period (AD 900-1300) and the Little Ice Age (AD 1400-contact), and was focused on cultures in the American Southwest, Great Basin, and Pacific coast, from California to Alaska. The data analyzed included osteological indicators of stress, pathological conditions, activity, and trauma, along with archaeological indicators of identity, migration, and conflict. Comparison of the bioarchaeological record from these distinct cultures in North America indicates that major climate events cause economic and ecology problems, but how people respond to the droughts, temperature drops, and changes in animal behavior involves complex sociopolitical issues beyond the environment. While catastrophic outcomes can happen with climate change, it is never the result of weather alone.

Metacarpal Ratio (2Mc:4Mc) and Its Relation to Sexual Dimorphism in Primates with Different Mating Strategies

EMILEE N. HART

Geography and Anthropology, Louisiana State University

Digit ratio (2D:4D) is a sexually dimorphic trait in mammalian hands that is a result of prenatal androgen exposure (PAE) during limb development. Previous studies show that females have a higher ratio than males and that sexual dimorphism in the ratio is greater in species with polygynous mating strategies and high levels of intermale aggression compared with monogamy and low intermale aggression. This study used metacarpals to test the hypothesis that the metacarpal ratio (2Mc:4Mc) will be more sexually dimorphic in polygynous species compared to monogamous species. Second and fourth metacarpals were measured on skeletonized animals for six species with different mating strategies (M=monogamy; P=polygyny) and levels of intermale aggression (H=high; I=intermediate; L=low; F=female; M=male). All animals were wild caught. Metacarpals rather than phalanges were used because digit position and side of phalanges could not be determined unequivocally. Sample sizes were as follows: *Hylobates lar* (M,L; 31F, 34M), *Aotus azarae* (M,L; 2F, 6M), *Trachypithecus cristatus* (P,I; 24F, 14M), *Presbytis rubicunda* (P,I; 15F, 17M), *Macaca fascicularis* (P,H; 11F, 12M), and *Alouatta seniculus* (P,H; 9F, 9M). Results comparing means do not support the hypothesis. The sexes are nonsignificantly different in metacarpal ratio in *A. seniculus, A. azarae, H. lar*, and *M. fascicularis*; males have a significantly higher ratio than females in *P. rubicunda*, but females have a significantly higher ratio than males in *T. cristatus*. Results are not consistent with previous research on digit and metacarpal ratios. Metacarpals and phalanges may respond differently in their growth and PAE.

A biplanar X-ray approach for studying the 3-D dynamics of human track formation, and its implications for interpreting anatomy and motion from fossil hominin tracks

KEVIN G. HATALA[1,2], DAVID A. PERRY[3] and STEPHEN M. GATESY[3]

[1]Department of Biology, Chatham University, [2]Center for the Advanced Study of Human Paleobiology, The George Washington University, [3]Department of Ecology and Evolutionary Biology, Brown University

The number of known Plio-Pleistocene hominin track sites has increased dramatically in the past decade. These data have the capacity to inform long-standing debates regarding fossil hominin locomotion, but there is no consensus on how to infer gait biomechanics from them. This is due to our limited understanding of the complex interactions between anatomy, motion, and substrate that generate a track. Insights regarding these interactions are elusive because: 1) data from stiff-surfaced instruments (e.g., pressure plates) cannot be extrapolated to deformable substrates, and 2) direct visualization of interactions between feet and deformable substrates are hindered by foot and substrate opacity.

In this study, we developed new biplanar X-ray methods to visualize and analyze the 3-D dynamics of three human subjects' feet as they walked across four substrates (three deformable muds and solid carbon fiber). Using skin markers, we directly analyzed 3-D motion at the foot-substrate interface. We found that foot dynamics were significantly influenced by substrate deformability. Both the heel and medial longitudinal arch deformed to greater extents as substrates became more rigid ($p < 0.01$ via repeated measures ANOVA). In deformable muds, we found that the 3-D topography of resulting tracks did not directly reflect foot motion. Deviations between motion and track depth differed significantly across regions of the foot, and across substrate types ($p < 0.01$ via repeated measures ANOVA). These results highlight the complexity and dynamic nature of track formation, and suggest critical revisions to some existing methods for inferring foot anatomy and motion from hominin tracks.

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New fossil material of *Homo naledi* from the Dinaledi Chamber, South Africa

JOHN HAWKS[1,2], MARINA C. ELLIOTT[2], ELEN M. FEUERRIEGEL[2,3], NOMPUMELELO HLOPHE[2,4], RICK HUNTER[2], HANNAH MORRIS[2,5], BECCA PEIXOTTO[2,6], MAROPENG RAMALEPA[2], MATHABELA TSIKOANE[2], STEVEN TUCKER[2], DIRK VAN ROOYEN[2] and LEE R. BERGER[2]

[1]Department of Anthropology, University of Wisconsin-Madison, [2]Evolutionary Studies Institute, University of the Witwatersrand, [3]Department of Anthropology, University of Washington, [4]Department of Anthropology, Georgia Southern University, [5]Integrative Conservation and Forestry and Natural Resources, University of Georgia, [6]Department of Anthropology, American University

The Dinaledi Chamber lies within the Rising Star cave system, Cradle of Humankind World Heritage Site, South Africa. In 2013 and 2014, more than 1500 hominin specimens were recovered from the surface of the chamber and a limited (80 cm x 80 cm) excavation area. Subsequent to these initial explorations, in 2015 and 2016 excavators recovered a small sample (n = 79) of hominin remains during the course of collecting specimens suitable for geological dating approaches. In 2017, new excavations were undertaken in the chamber, resulting in the recovery of additional hominin remains now under study. Here we provide descriptions of hominin specimens from these new samples. Notable aspects of the 2015-2016 sample include dental remains that can be tentatively associated as antimeres or metameres of teeth from the 2013-2014 collection, direct refits between newly-recovered specimens and long bone fragments from the 2013-2014 collection, and a number of complete or near-complete pedal elements. We also report on ongoing laboratory analysis of material from the 2017 excavation. All hominin material from these samples is compatible with *H. naledi*. Three-dimensional prints of fossil material will be available for inspection at this presentation.

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A Test of the Metric Method for Estimating Sex Using the Human Radius

LEIGH A. HAYES and JORDAN KARSTEN

Anthropology, University of Wisconsin Oshkosh

Being able to accurately identify the sex of unknown skeletal remains is crucial for forensic anthropologists and bioarchaeologists. In

order for a method to be considered viable in a courtroom, it needs to have been tested and have a known error rate. The method currently accepted for sexing using the radius was developed by Berrizbeitia in 1989, using the Terry Collection. Berrizbeitia claims that by using the maximum and minimum radial head diameters sex can be estimated with an accuracy rate of 96%. However, this method has not yet been independently tested on another large skeletal collection of known sex. We analyzed 241 radii from the Hamann-Todd Collection to determine the accuracy of determining sex from the radius. Our sample consisted of 121 males and 120 females. Using the guidelines published by Berrizbeitia, we achieved an accuracy rate of 69%. Our statistical analysis has shown that there is a significant difference in the size of the minimum and maximum radial head diameters between males and females. The results of our research calls into question the utility of using osteometric data from the radial head for sex determination.

Opportunities and constraints in women's resource security among agro-pastoralists in Kaokoveld, Namibia

ASHLEY HAZEL[1,2], GILLIAN MEEKS[3] and JAMES HOLLAND JONES[1,2,4]

[1]Earth System Science, Stanford University, [2]Woods Institute for the Environment, Stanford University, [3]Anthropology, Harvard University, [4]Life Sciences, Imperial College London

In most societies, women's access to high-status resources is constrained by inheritance rules and cultural norms. Nevertheless women mostly oversee fulfillment of their household's basic needs, including food, healthcare, and education, so freedom to manage other resources may offer critical flexibility in variable and/or changing environments. Using our 2009 cross-sectional dataset of 213 women living across 28 agro-pastoralist villages in Kaokoveld Namibia, we conducted principal-component analysis to identify variables that contribute to a composite measure of relative resource security among Kaokoveld women. The first two principal components (PCs) accounted for 40% of the variation in women's resources. PC2 mostly accounted for women's direct food access (garden maize yield and variety of daily foods eaten) and a well-defined cluster along the y-axis is visible. However, PC1 pulls women away from the horizontal cluster according to their ability to trade livestock for maize or other important household needs (e.g., clinic fees). Importantly, most of the resource gains represented by PC1 are from goats, not cattle. Higher values for an index variable based on PC1 were significantly positively associated with having fewer miscarriages and negatively associated with being older and widowed/divorced. These results highlight how women manage resources despite having less access to high-status resources than men. Specifically, use of goats as a commodity to obtain food and cash suggests that some women have flexibility during drought when gardens fail and cattle market value and survivability decreases. Women's strategies may become increasingly important as pastoralist economies face existential threats from climate change.

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The quantitative genetic analysis of craniometric phenotype of Yin Ruins population, Anyang

LETIAN HE[1,2,3] and WU LIU[1]

[1]Paleoanthropology, Institution of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, [2]Paleoanthropology, University of Chinese Academy of Sciences, [3]Sociology and Anthropology, George Mason University

Yin Ruins was the capital of the last phase of the Shang Dynasty (3250-2996 B.P.) located in the north of Henan province, China. A large number of human skeletons excavated from this site have played an important role for understanding population history of the Yin Ruins and northern China.

Previous researchers focused on the population structure of the Yin Ruins from the perspective of ethnology. Previous studies found that the sacrifice pits (JSK) samples consisted of five different populations. However, some scholars hold different views. This study analyzes the craniofacial shape variation of the medium and small tombs(ZXM) and JSK samples to explore their population history. A total of 212 adult skulls belonging to these two groups are analyzed in this article. The comparative data include 414 skulls from nine sites in northern China (4800-2000 BP). PCA and R-matrix analysis are used to study variance among populations. The results suggest that: (1) previous studies using racial classification drastically oversimplify population variation in this sample. (2) Most of ZXM specimens have closer genetic distance with the late Neolithic population in local region, and there is evidence for intensive gene flow between the ZXM population and the residents of middle and lower reaches of the Yellow River. (3) The craniofacial morphological variation of JSK group is higher. However, they do not have evidence of gene flow from Europe or Oceania. (4) In northern China, gene flow among populations is likely to be limited by geography during the Bronze Age.

Morphometric Analysis of the Stw-431 (*Australopithecus africanus*) Lumbar Vertebral Series

AMBER N. HEARD-BOOTH[1], WILLIAM J. SANDERS[2] and LIZA J. SHAPIRO[3]

[1]Department of Radiology, Michigan State University, [2]Museum of Paleontology and Department of Anthropology, University of Michigan, [3]Department of Anthropology, University of Texas at Austin

Since their excavation in 1987, the lumbar vertebral elements of partial skeleton Stw-431 (*Australopithecus africanus*) have been discussed in the context of vertebral number and spinal pathology. However, morphometric analysis of these elements has yet to be undertaken. Here, we present a morphometric analysis of the lower six pre-sacral vertebrae of Stw-431. Measurements of the fossil elements were collected on the original specimens and were used to calculate shape indices of the vertebral bodies, pedicles, and zygapophyses. These data were compared between vertebral levels within the Stw-431 series, and also with a broad sample of primates representing a range of body sizes and positional behaviors.

Overwhelmingly, the Stw-431 lumbar vertebrae exhibit human-like morphology consistent with orthograde posture and bipedalism. Moving caudally through the spine, the Stw-431 elements exhibit an increase in absolute width of the vertebral bodies and pedicles, particularly at the penultimate and last lumbar levels. Ratio of pedicle width to height also increases caudally in Stw-431, with values similar to modern humans and larger than other australopithecines (*e.g.*, Sts-14). The distance between the prezygapophyses also increases relative to vertebral body width in the lower spine, similar to humans and Sts-14. Dorsal wedging, consistent with lumbar lordosis, is present at the last vertebral level. Regression analysis demonstrates that Stw-431 had relatively small vertebral bodies for its body size, however, indicating a mosaic acquisition of bipedal adaptations in the australopithecine spine in which changes first occurred along the posterior pillar (*i.e.*, neural arch).

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The effect of third molar impaction on age estimation in males

KELLY N. HEIM and MARIN A. PILLOUD

Anthropology, University of Nevada, Reno

The development and eruption of teeth are commonly used in the age estimation of subadults. Although there is considerable variation in third molar development, it is still a useful age indicator for late adolescence and may be

helpful in determining the age of majority in medico-legal cases. While it is clear that a relationship exists between chronological age and third molar development, the effect of molar impaction on development and age estimation has not been well documented. This study explores the effect of impaction on development and by extension on age estimation methods.

Data were collected on radiographs of identified male individuals (n=141) analyzed at the Central Identification Laboratory as part of the Defense POW/MIA Accounting Agency. Radiographs were scored for dental development stage and the ancestry-appropriate age estimation method was used to estimate age-at-death. This group was then divided into two cohorts: individuals with impacted third molars (n=60) and those without (n=81) to explore differences in the accuracy of the age estimation methods as related to molar impaction.

Proportions of impacted third molars were compared to those in occlusion, and age estimates for impacted teeth were significantly more likely to be inaccurate ($p<0.0000$). In the cohort with impactions, unimpacted teeth also provide inaccurate age estimates ($p<0.0076$), suggesting that individuals with at least one impaction tend to have under-developed third molars.

Based on this research, care should be taken when estimating age on an individual with at least one impacted third molar as such methods have the potential to underage.

Is there evidence of a medieval intrusion of Pathans into the Vale of Peshawar, Pakistan? A dental morphology approach

BRIAN E. HEMPHILL[1], INAM ULLAH[2], MUHAMMAD TARIQ[3], MUHAMMAD ZUBAIR[2], NAZIA SAADIQ[2] and HABIB AHMAD[4]

[1]Anthropology, University of Alaska, Fairbanks, [2]Genetics, Hazara University, [3]Omic Studies, Islamia College, [4]Vice-Chancellor's Office, Islamia College

Historical documents and oral traditions maintain that groups of ethnic Pathans emigrated from Afghanistan to northern Pakistan during the 15th through 17th centuries. However, the number of migrations, their size, composition, and frequency of intermarriage with members of non-Pathan Pakistani ethnic groups remain unknown. This study employs 17 tooth-trait combinations of the Arizona State University Dental Morphology System among 1,495 living individuals of 10 Pathan ethnic groups of Khyber Pakhtunkhwa Province, Pakistan. These data were contrasted with data obtained from 2,583 individuals of 12 ethnic groups from the same region of northern Pakistan. Correspondence analysis was used to determine which tooth-trait combinations are most effective in distinguishing samples. Intersample affinities based upon pairwise MMD values were examined with neighbor-joining cluster analysis (NJ) and multidimensional scaling (MDS).

Results are largely consistent across data reduction techniques yielding three sample aggregates. Non-Pathan groups are subdivided between those of the Karakoram highlands and those residing in the foothills rimming the northern border of the Indus Valley. Pathan ethnic groups largely show greatest affinities to one another, but affinities are somewhat diffuse, and there are exceptions. Such results confirm the intrusive nature of Pathan ethnic groups in northern Pakistan and suggest there were multiple immigration events, some of which were likely limited in number and involved substantial admixture with local resident non-Pathan ethnic groups residing within the Vale of Peshawar.

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Parasites as proxies: Experimental lice studies inform our understanding of human evolution and health

CORY HENDERSON[1], ROSS CAVALIERI[2], JOHN CLARK[2] and GEORGE PERRY[1,3]

[1]Biology, Pennsylvania State University, [2]Veterinary and Animal Sciences, University of Massachusetts, Amherst, [3]Anthropology, Pennsylvania State University

Evolutionary and ecological studies of human parasites can provide novel insight into our evolutionary history. Human head and body lice (*Pediculus humanus spp.*) are recently diverged and may have differentially adapted to live and lay eggs on human hair and clothing, respectively. Interestingly, body lice are vectors for three major human diseases (epidemic typhus (*Rickettsia prowazekii*), trench fever (*Bartonella quintana*), and relapsing fever (*Borrelia recurrentis*)), while head lice are not competent vectors for these or other known pathogens. We have performed whole genome sequencing studies on lab populations of head and body lice with up to 20x coverage, identifying on average 1.9 million heterozygous SNPs per individual genome. The hybrid offspring of lab colony head and body lice are viable; we are in the process of sequencing and analyzing the genomes of F1 and F2 generation crossed head and body lice to confirm the ability to accurately identify and track head and body lice origin chromosome segments through these generations. The results of this study will facilitate the use of F2 head-body lice in functional genomics experiments in which we will identify and study the evolutionary history of genomic regions associated with fitness on human hair and clothing substrates and with *B. quintana* vector competency variation.

Sleeping tree selection of olive baboons (*Papio anubis*) in Nigeria

KYLE T. HENDRIKSON[1,2], VALERIE A.M. SCHOOF[1,3] and VOLKER SOMMER[2]

[1]Biology, York University, [2]Anthropology, University College London, [3]Biology Program, Multidisciplinary Studies Department, Glendon College, York University

Primates spend a significant amount of their lives at sleeping sites. Therefore, examining the characteristics and locations of sleeping trees helps to document important aspects of primate socioecology. We studied 42 sleeping trees used by olive baboons (*Papio anubis*) at Gashaka-Gumti National Park (GGNP), Nigeria, to test three non-mutually exclusive hypotheses: (1) predation avoidance, (2) parasite avoidance, and (3) comfort. GGNP's forested area offered an opportunity to examine these hypotheses in a unique baboon population. The characteristics of sleeping trees were compared to those of trees along two botanical transects within GGNP. GGNP's baboons preferred certain genera, while avoiding others; three genera (*Erythrophleum, Pseudospondias,* and *Canarium*) accounted for 60.0% of sleeping trees, which exceeds their relative abundance in the botanical transects where they comprised 10.4% of trees. Sleeping tree diameter at breast height was twice that of transect trees (DBH: 53.70±19.41cm vs. 24.33±15.87cm; Welch's $t=20.03$, $df=254{,}305$, $p<0.001$) and also had a greater number of canopy connections (median=6 vs. 3 connections; $X^2=81.39$, $df=1$, $p<0.001$). Of 42 sleeping trees, only four were reused, possibly reducing parasite exposure associated with the accumulation of fecal matter at sleeping sites. Individuals slept at horizontally oriented Y-shaped branch structures more frequently than other branch structures (53% of observations). Our results indicate that GGNP's baboons did not randomly select sleeping trees, instead preferring large trees that may be challenging for predators to enter and that offer a possible escape route via multiple canopy connections, trees where parasite infection risk is low, and sleep structures that provide comfort.

Co-evolution of host and pathogen in three major human infections: a paleopathological perspective

MACIEJ HENNEBERG[1,2] and TEGHAN LUCAS[3,4]

[1]Biological Anthropology and Comparative Anatomy Unit, The University of Adelaide, Australia, [2]Institute of Evolutionary Medicine, University of Zurich, Switzerland, [3]Department of Archeology, Flinders University, Australia, [4]Anatomy, School of Medical Sciences, University of New South Wales, Australia

Pathogens can either kill the host quickly therefore damning its own spread or they can invade the host without causing death, thus ensuring their own survival, reproduction and spread.

Tuberculosis, leprosy and treponematoses are three widespread infectious diseases that do not kill the host immediately. A co-evolution of the host and the pathogen has likely occurred in their history. Paleopathological records of the three diseases are extensive, spanning some 200 human generations. The paleopathological prevalence of each disease has been well documented in the form of published compilations recording each known case. We have re-analysed the data from these compilations to test whether changes in the prevalence of each disease over time indicate the co-evolution of the pathogen and human host. Prevalence of each of the three diseases showed a significant trend over time (Chi-squared, $p<0.001$). Overall, there was a decline in the prevalence of each disease over time. A trend started with the increase in the disease's prevalence and then the prevalence of the disease declined; this is best demonstrated in the case of leprosy. The increase of the prevalence of the disease appears in the initial period of host-disease contact when the co-adaptation has not yet occurred, it is followed by a decline resulting from co-adaptation that is mutually beneficial for the spread and maintenance of the pathogen and the host that, as a result, suffers less pathological reactions to the infection. Eventually, either the host becomes immune, or the pathogen tends to become commensalic rather than parasitic.

Predominant collagen fiber orientation (CFO) is a stronger predictor of load history than drifting osteon prevalence or osteon population density (OPD of conventional osteons): An evaluation in bending regions of adult human fibulae, femora, and chimpanzee femora

MARSHALL K. HENRIE, ETHAN D. FINLINSON, JAMES S. SMITH, KENDRA E. KEENAN and JOHN G. SKEDROS

Orthopaedics, University of Utah

Drifting osteons (DOs) might be extreme manifestations of how osteons influence toughness by introducing interfaces and collagen/lamellar patterns that arrest/slow microdamage propagation. Studies of DOs along with OPD, CFO, and their direction of transverse drift (DTD) can advance understanding of DO biomechanics and help determine if regional variations in their prevalence are useful for interpreting load history. We examined diaphyseal cortices of adult fibulae (AAPA meeting 2016, n=11) and drew comparisons with our previously reported data from upper diaphyses of adult chimpanzee and human femora. As in the femora, fibulae were also examined in circularly polarized light for DO prevalence and compared with OPD and CFO data. The posterior and medial quadrants ("compression region") had: (1) more DOs compared to the opposite combined cortices ($p=0.002$), resembling chimpanzee femur data but opposite of results in human femora; (2) a trend ($p=0.08$) in more oblique-to-transverse CFO (previously reported) resembling the significant tension vs. compression differences in chimpanzee/human femora; (3) no trends or statistical significance in OPD data. Fibulae showed weak negative correlation between OPD and DO prevalence ($r=-0.35$; $p<0.001$) but no correlations between OPD and CFO ($r=0.06$; $p<0.001$), or DOs and CFO ($r=0.09$; $p<0.001$). In fibulae, DOs had preferential DTD towards the endosteum (anterior 47%; lateral 70%; posterior 58%; medial: 62%). Lack of preferential DTD in the femora casts doubt that the DTD in fibulae reflects predilection for marrow or low strain. These results show that CFO variations are much stronger correlates than DO prevalence for identifying a bending load history.

Twenty years of ranging patterns in hamadryas baboons: a modern take in a changing climate

MEGAN C. HENRIQUEZ[1,2] and LARISSA SWEDELL[1,2,3,4]

[1]Anthropology, The Graduate Center, City University of New York, [2]Physical Anthropology, New York Consortium in Evolutionary Primatology, [3]Anthropology, Queens College, City University of New York, [4]Archaeiogy, University of Cape Town, Rondebosch, South Africa

The recent rise in global temperatures has highlighted the importance of long term studies on animal populations that may potentially be adversely affected by climate change. The population of hamadryas baboons at the Filoha outpost of Awash National Park in central Ethiopia has been studied for over 20 years, providing an opportunity to examine the relationship between climatic variation and changes in baboon spatial ecology over time. Additionally, anthropogenic factors such as the expansion of nearby farms and human-wildlife conflict, have played a role in changes in baboon habitat use and movement patterns over time. Here, we examine the effects of both long term climatic changes and anthropogenic factors on the home ranges and daily path lengths of the hamadryas baboon population at Filoha. Starting in 2013, several adult males in this population were outfitted with GPS collars in order to more precisely monitor group movement. Between 1996 and 2006, annual average temperature at Filoha increased by approximately 1.2°C and rainfall increased by approximately 7 mm. The home range size and daily path lengths of our main study group have also increased during this time. We discuss these results in the context of long-term effects of rising global temperatures and anthropogenic activities on this species. Given the notable flexibility and adaptability of baboons – with hamadryas being no exception to this general pattern – our findings have important implications for how animals may adapt and cope in a world affected by climate change.

Cranial variation in the Italian peninsula from the Iron Age to the Middle Ages

SAMANTHA M. HENS

Anthropology, California State University Sacramento

The Italian peninsula is expected to exhibit considerable population variability due to the rise and fall of the Roman Empire, related migrations and trade networks. This research examines changes in cranial shape in Italy beginning in the Iron Age, through Imperial Roman times, and the Middle Ages using four samples (N=142) exhibiting regional and temporal variation. Individuals from Pontecagnano in southern Italy represent Iron Age (4^{th}-7^{th} centuries BCE) populations, individuals buried at Isola Sacra and Velia represent central and southern Italy respectively, and date to the Imperial Roman Era (1^{st}-3^{rd} centuries CE); while the individuals from Portico d'Ottavia represent a population from the center of Rome dating to the Middle Ages (9^{th}-12^{th} centuries CE). Data were recorded from 18 cranial three-dimensional landmarks and analyzed using Procrustes Superimposition and associated multivariate statistics in MorphoJ.

Procrustes ANOVA statistics were unable to detect any significant group differences for centroid size ($p=0.5674$); however, shape changes were significant ($p<0.0001$). Procrustes distance values indicated that all groups were significantly different from one another except for the Medieval Portico-d'Ottavia site and the Imperial Roman site of Isola Sacra ($p=0.0635$), suggesting some level of continuity in the area around Rome after the fall of Rome. Interestingly, the Iron Age site of Pontecagnano was significantly different from the Imperial Roman site of Velia ($p=0.0002$) despite their close regional proximity, suggesting the influx of Greek settlers along the southern Italian coast may have increased biological distance between the two sites by Imperial Roman times.

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Postpartum Maternal Health and the Edinburgh Postnatal Depression Scale among the Hadza Foragers

KRISTEN N. HERLOSKY, DANIEL C. BENYSHEK and ALYSSA N. CRITTENDEN

Anthropology, University of Nevada, Las Vegas

The postnatal period immediately following birth is a time of critical importance for both mother and offspring due to the vulnerabilities associated with internal and external health factors. Previous research has explored evolutionary origins and

mismatch explanations for the onset of depression, yet few studies have directly addressed cross-cultural variation and intra-cultural diversity in the manifestation of post-partum depression in small-scale non-industrial populations. Here, we present the first investigation of postpartum maternal mood among the Hadza foragers of Tanzania. We administered the Edinburgh Postnatal Depression Scale (EPDS) to twenty-three women, ranging in age from 15- 40 years, all with infants under the age of 12 months. Our results suggest that eleven of the twenty-three women would be considered at risk for depression (12 cut-off score). Additionally, the mean average score of all responses (11.56%) places Hadza women above average in comparison to other populations for which we have data. We further analyzed relevant demographic characteristics, including household composition, presence of mother in camp, parity, and age at first birth and found no associations. Follow up interviews revealed that the language used in the EPDS diagnostic tool may have influenced how mothers perceived the questions, with many women interpreting questions about "sadness" after delivery to be inquiring about level of physical pain. These results suggest that an unusually high proportion of Hadza women are depressed postpartum, or that the cross-cultural applicability of clinical diagnostics needs to be re-evaluated to take into account cross-cultural perceptions of health in non-western populations.

Understanding the factors that influence non-human primate genomic data generation

MARGARITA HERNANDEZ[1] and GEORGE PERRY[1,2]

[1]Department of Anthropology, [2]Department of Biology, Penn State University

The rapid advance of genomic sequencing technologies over the last decade has profoundly changed the field of conservation genetics by facilitating the generation of genome-scale sequencing data for population samples of threatened, non-model species. The availability of genomic data, however, appears to be unevenly distributed among taxa, potentially imparting downstream biases in biodiversity and other studies that incorporate available genomic data into their analyses. Here, we present an approach to quantify and study the reasons underlying the uneven distribution of published genomic-scale sequence data, using non-human primates as a case study. We present a meta-analysis of over 60 terabytes of published non-human primate genomic-scale sequence data that have been deposited in public data repositories (e.g. the NCBI Sequence Read Archive), evaluated in the context of phylogeny, geographic location, conservation status, model organism status, captivity status, and species-level genetic diversity. Our preliminary results suggest strong biases associated with model organism status and phylogenetic distance to humans, with rhesus macaques, green monkeys, and chimpanzees comprising ~61% of the total data deposited, and only ~22% of all non-human primate species represented in the database at all. We are also conducting ongoing ethnographic interviews of first/senior authors of papers that presented new non-human primate genomic data to better understand decision-making processes involved in the selection of species for the generation of genomic sequence data. This work illuminates the disparities in genomic data for underrepresented primate species in the literature and identifies primate taxa that should be targeted by future genomic data generation efforts.

Correspondence Between Cranial Morphological Regions and mtDNA in western South America

BRIANNE HERRERA[1] and MARK HUBBE[1,2]

[1]Anthropology, The Ohio State University, [2]Instituto de Arqueología y Antropología, Universidad Católica del Norte, Chile

The ways in which microevolutionary events have affected modern human cranial variation are not well understood. While a consensus exists that cranial shape can be used to reconstruct phylogenetic relationships among modern human populations, different cranial regions can generate significantly different associations. Many global studies have suggested the basicranium to be more congruent with neutral genetic markers and the face to be highly variable. Here, we test the association of different anatomical regions of the cranium to mtDNA frequencies using samples from western South America in order to explore if these global patterns hold true in a region of the world that has facilitated higher rates of gene flow in the past. 63 different 3D landmarks were measured on samples from three countries (six sites) and divided into three datasets (face, neurocranium, and basicranium). Cluster analyses and multi-dimensional scaling were performed on each region of the cranium to explore the congruences between datasets. Mantel tests were then performed between Mahalanobis distance matrices for each cranial region and mtDNA haplogroups from geographically similar populations. Our results show that the neurocranium is correlated with mtDNA ($r= 0.5762$; $p= 0.0167$), but the face ($r= 0.2581$; $p= 0.01764$) and basicranium ($r= 0.1299$; $p= 0.3792$) are not, suggesting that the neurocranium is tracking biological history better in these populations than either the face or the basicranium. In conclusion, we need to better understand how regional patterns of development and evolution affect the overall pattern of microevolutionary events on cranial morphology.

How Does Captivity Influence Parasitism? A Comparative Study of Wild and Captive Primates

JAMES P. HERRERA[1], DEBAPRIYO CHAKRABORTY[2], JULIE RUSHMORE[3], SONIA ALTIZER[3] and CHARLES L. NUNN[1,4]

[1]Evolutionary Anthropology, Duke University, [2]PREDICT, EcoHealth Alliance, [3]Odum School of Ecology, University of Georgia, [4]Duke Global Health Institute, Duke University

Captivity creates a novel environment for animals in many ways, including exposure and susceptibility to parasites. Many parasites are predicted to be lost, especially when captive hosts are no longer in contact with vectors or intermediate hosts from their native environments. In contrast, parasites are also predicted to be gained in captivity, through cross-species transfers from humans and other animals. We investigated the effects of captivity on parasitism by comparing parasite richness and turnover in parasite community composition between wild and captive primates, with analyses including both macro-parasites (helminths and arthropods) and micro-parasites (viruses, protozoa, bacteria, and fungi). We found no significant differences in parasite richness between captive and wild primates (phylogenetic t-test, $t = -0.85$, $p = 0.41$). The composition of the parasite communities shifted in captive populations, with evidence of both nestedness (holdovers from the wild, 0-26% of community change) and turnover (new parasites acquired in captivity, 0 – 100% of change). Primates were more likely to lose parasites that were vector-borne and with intermediate hosts from the wild into captivity. Hosts were more likely to gain generalist parasites that are transmitted environmentally and by close contact, including through fecal-oral and sexual transmission. Parasites that exhibit complex transmission involving multiple hosts were commonly missing in captive compared to wild primates. These findings demonstrate that parasite communities in captive primates are a unique assemblage compared to parasite communities in the wild, and identify types of parasites that require greater monitoring in captive environments.

Living in Yucatan during the Late Pleistocene: The odontology of Naia

RUBEN HERRERA[1], PILAR LUNA[2], JIM C. CHATTERS[3], JULIO CHI KEB[4] and ANDREA CUCINA[4]

[1]Facultad de Odontologia, Universdad Autonoma de Yucatan, [2]Direccion de Arqueologia Subacuatica, INAH, [3]Applied, PaleoScience, [4]Facultad de Ciencias Antropológicas, Universidad Autónoma de Yucatan

The present study reconstruct dietary and living conditions of Naia, a 15-16 years old female who inhabited the Peninsula of Yucatán about 13,000 years b.p. Her mortal remains were recovered in 2014-2016 from the bottom of a sinkhole near Tulum. From a morphognatic perspective, she

manifested a noticeable mandibular retrognatia and a very deep palate, with dental crowding being evident in the anterior teeth of both arcades, and impacted mandibular third molars. Although not clinically relevant for the modern odontostomatology, it indicates a limited masticatory activity during growth. This is also evident from the very limited occlusal wear which, despite the individual's young age, only shows minor wear facets that minimally and very superficially affect the enamel. Mastication of soft foods can be inferred also from the rate of carious lesions, which suggest the ingestion of non-fibrous and cariogenic foodstuffs. Despite her young age, Naia sported carious lesions in eleven out of the 26 teeth available for study, which translates into 42.3% of teeth affected by caries (53.4% if we include caries at the enamel level). Similarly, she manifested noticeable problems of alveolar retraction due to periodontal inflammation. It is likely that Naia, alongside a cariogenic diet, also suffered from a reduced saliva autoclisis, which is evident from the chemical demineralization of the maxillary central incisor. Naia only represents one individual and not the Late Pleistocene population as a whole; overall, her oral conditions indicate a soft diet in which cariogenic foods, likely local fruits, played an important role.

Demography and Health of the Hellenistic to Early Christian burial samples from Ayioi Omoloyites neighborhood in Nicosia, Cyprus

NICHOLAS P. HERRMANN[1], KRYSTEN A. CRUZ[1], CHRISTOPHER A. WOLFE[1], DESPO PILIDES[2] and YIANNIS VIOLARIS[2]

[1]Anthropology, Texas State University, [2]Cyprus Museum, Department of Antiquities, Republic of Cyprus

The primary goal of the Ayioi Omoloyites Bioarchaeological Project is to document and interpret the commingled human remains recovered from three Hellenistic to Early Christian rock-cut tombs located south-southwest of the old city walls of Nicosia, Cyprus. Laboratory research over the past two years have focused on the inventory, assessment, and contextualization of the remains. In 2017, the osteological inventories of two of the three tombs (Tomb 47 and 48) were completed and nearly half of Tomb 49 was documented. Altogether, 4844 skeletal elements have been examined with 540, 428, and 3876 elements from Tomb 47, 48, and 49, respectively. Minimum Number of Individuals (MNI) estimates based on zonal scores and demographic parameters suggest varied uses of the tombs. Radiocarbon dates in combination with stable isotope assays from select elements provide evidence of the later use of Tomb 49 as an early Christian ossuary and suggest a diverse diet of these early Nicosians. Pathological lesions in adult and subadult remains are recorded on a total of 422 skeletal elements. Over half of these lesions (52.1%) relate to degenerative joint disease (joint or vertebral). Nearly one-third of the lesions (32.8%) relate to bone formation (periostistis or enthesopathy). Fractures represent 5.9% of the skeletal lesions. The remaining 9.2% of skeletal pathologies are split between bone loss, porotic hyperostosis, and element shape changes. Issues of health, injury, infection, and social interaction are explored in relation to the archaeological record of early Nicosia and contextualized within the broader Cypriot Hellenistic and Roman experience.

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Behavioral interventions for maternal overweight and obesity: Exploring the implications for health and health care inequalities

KATHRYN HICKS

Department of Anthropology, University of Memphis

There has been a recent proliferation of experimental and epidemiological research focused on the relationship between maternal overweight and obesity, and offspring health. For example, in animal models, maternal obesity induced by a high-fat-diet has been associated with altered lipid metabolism and higher fat mass, among a range of other effects, and similar patterns are apparent in humans. Framed using terms like epidemic, crisis and vicious cycle, this work highlights the contribution of mothers to an increased prevalence of obesity, and stresses the need for intervention to improve population health. In particular, although many of these authors recognize the potential importance of 1) the transmission of metabolic information across multiple generations, 2) systematic and historic structural inequalities, and 3) paternal contributions to shaping children's health, suggested interventions are generally centered on addressing mothers' "lifestyle." This term implicates individual knowledge and consumer choice as the primary drivers of body composition. In this paper, I systematically review scholarly and popular publications on interventions designed to address maternal overweight and obesity. I explore the implications of gendered, lifestyle-focused language for shaping women's experiences of pregnancy and access to health care. I find that this approach has a range of potential negative consequences for women and children. These include an increase in surveillance and negative interactions in obstetric care, and contributions to harmful stereotypes about specific "at-risk" populations, including racial minorities. I discuss the importance of situating overweight and obesity in historical and social context for designing appropriate and effective public health strategies.

Sexual selection in male rhesus macaques: genes, physiology, morphology, behavior, & life-history

JAMES P. HIGHAM

Anthropology, NYU

In many primate species exhibiting polygynandrous mating systems, the alpha male position is a result of contest competition. Alpha males obtain a large share of sires, resulting in strong linear directional selection for large and weaponized males. In contrast, studies of rhesus macaques on Cayo Santiago have found that males obtain dominance by queuing, perhaps because the alpha male share of paternity has been found to be relatively low, and variable by year and group, such that the position is often not worth fighting over directly. This set of genetic and behavioral results is consistent with morphology – rhesus macaques are less sexually dimorphic in body and canine size than many macaque species, and exhibit large relative testis volume, indicating weak direct, and strong indirect, male-male competition. Such a scenario creates flat fitness landscapes with multiple peaks, the existence of diverse and divergent reproductive strategies within the same population, and the potential for selection for multiple morphotypes. Here, I present decades of data from genetics, physiology, both hard and soft-tissue variation, behavioral observations and experiments, and results of life-history patterns of reproduction and mortality. I use all these lines of evidence to assess whether multiple male strategies are indeed operating and being maintained, and whether as a result, processes of balancing and disruptive selection have created multiple male morphotypes. Rhesus macaque males are a wonderful model system, in which multiple mechanisms of sexual selection operate simultaneously to produce and maintain intra-specific genotypic and phenotypic diversity.

Intrasexual rivalry, intersexual choice, and men's fitness

ALEXANDER K. HILL[1], JESSICA L. BURNS[2], JEREMY KOSTER[3], JEFFREY WINKING[4], ROBERT P. BURRISS[5] and DAVID A. PUTS[6]

[1]Anthropology, University of Washington, [2]Anthropology, University of Utah, [3]Anthropology, University of Cincinnati, [4]Anthropology, Texas A&M University, [5]Psychology, University of Basel, [6]Anthropology, The Pennsylvania State University

Men's secondary sex traits predict attractiveness, dominance, and mating success. Although intrasexual rivalry and intersexual choice may have differed in relative strength across men's traits ancestrally, recent research suggests that contest competition may generally have influenced the male phenotype more than have female preferences. However, few available data link men's putative sexually selected traits to success under mate choice and contests, and to mating and

reproductive success, in natural fertility populations. We therefore explored the relative degrees to which these mechanisms of sexual selection mediate relationships between male traits and fitness in a small-scale Central American society with minimal use of contraception. In 51 men aged 20-40 years, we measured sexually dimorphic traits of the face, voice, and body, as well as success in male contests, female choice, mating, and reproduction. Multiple regression analyses revealed that (1) men's secondary sex traits predicted dominance, and not attractiveness, but that (2) attractiveness, and not dominance, predicted fitness outcomes with age controlled. This is attributable to greater quantity, not quality, of female mates. We discuss implications of these results concerning the relative importance of intrasexual and intersexual selection in men.

Current research on Late Pleistocene and Early Holocene human remains from the Bladen Nature Reserve in southern Belize

ETHAN C. HILL[1], EMILY MOES[1], WILLA R. TRASK[2,3], EMILY KATE[4], CATRIONA MCKENZIE[5], HEATHER J.H. EDGAR[1], DOUGLAS J. KENNETT[4] and KEITH M. PRUFER[1]

[1]Anthropology, University of New Mexico, [2]Defense, POW/MIA Accounting Agency, [3]Anthropology, Texas A&M University, [4]Anthropology, Penn State University, [5]Archaeology, University of Exeter

The Bladen Paleoindian and Archaic Archaeological Project (BPAAP) has excavated the remains of over 30 individuals from the Saki Tzul and Mayahak Cab Pek rock shelters in the Maya Mountains of southern Belize. Early human remains from the New World tropics are rare, thus the BPAAP project can provide important information regarding biological and behavioral variation in Mesoamerica throughout the Holocene. To date, the human remains recovered from Saki Tzul and Mayahak Cab Pek represent males and females with ages at death ranging from neonatal to older adult. Persistent use of these rock shelters from the Late Pleistocene to the collapse of Maya civilization is suggested by a provisional radiocarbon chronology. The skeletons display numerous developmental and degenerative pathological conditions that are potentially indicative of diet, habitual behavior, and life history. Among the most frequently observed pathological lesions were changes indicative of osteoarthritic degeneration in the appendicular joints, evident in 55% of the adult individuals in this sample. Developmental defects were identified less frequently, but include two older adults that had incompletely fused sacral vertebrae. This detailed osteological and dental analysis aids us in developing a better understanding of trends in the human ecology of Paleoamerican and Archaic foragers over the course of the late Pleistocene and Holocene of Mesoamerica.

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Paleoclimate reconstruction from pedogenic carbonates from the early Miocene Wayando Formation, Mfangano Island, Lake Victoria, Kenya and the impact on early ape evolution

KAYLA R. HILLIS[1], LAUREN A. MICHEL[1], DAVID L. FOX[2], STEVEN G. DRIESE[3], DANIEL L. PEPPE[3], THOMAS LEHMANN[4] and KIERAN P. MCNULTY[5]

[1]Department of Earth Sciences, Tennessee Technological University, [2]Department of Geology and Geophysics, University of Minnesota, [3]Department of Geosciences, Baylor University, [4]Messel Research and Mammalogy Department, Senckenberg Research Institute and Natural History Museum, [5]Department of Anthropology, University of Minnesota

Changes to climate and the resulting changes to ecosystems are thought to be stressors leading to evolutionary adaptions. Early Miocene deposits on Rusinga and Mfangano Islands, Kenya, are ideal for studying the impact of environment on evolution and adaptation within early apes. Despite decades of geological and paleontological research there, however, paleoclimate reconstructions have been conflicting, ranging from open and arid to closed and ever-wet environments. Here, we present new results from paleosol-bearing deposits in the oldest fossiliferous unit, the Wayando Formation, on Mfangano Island. Results show that the Wayando Fm. contains interbedded ashes, groundwater nodules, and Calcisols with stage II and III pedogenic carbonate development. In modern soils, pedogenic carbonate is found in environments where evapotranspiration is greater than precipitation – common in semi-arid to arid environments. Micromorphology confirms a climate with little precipitation, as thin sections reveal unweathered igneous material including lapilli, volcanic rock fragments, and olivine crystals. This semi-arid to arid climate contrasts with previous interpretations for the Wayando Fm., and differs sharply from the paleoclimate and habitat reconstructed for the younger Hiwegi Fm., which include woodlands and closed-canopy forests.. These results add to a growing body of data showing that the Rusinga Group strata contain a wide variety of paleoenvironments in which *Ekembo* and other early Miocene catarrhines were living.

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A case of erosive arthropathy from the Late Archaic period of the Lower Pecos, Texas

CHARLES E. HILTON[1,2] and MARSHA D. OGILVIE[2]

[1]Anthropology, University at Albany-SUNY, [2]Texas Archeological Research Laboratory, University of Texas at Austin

Severe erosive arthropathies (EA) in ancient skeletons generate much interest in the anthropological and medical communities as their presence often raise questions regarding how individuals coped with such arthritic manifestations and whether other community members provided social support for afflicted individuals. Additionally, the advent of certain arthropathies are of particular interest to researchers wanting to understand the early occurrences of such disease forms. While EAs have been documented worldwide for prehistoric agriculturalists, they are seen less frequently in prehistoric forager human skeletal remains, partly due to a combination of low disease prevalence in low density populations and a low frequency of forager cemeteries on the landscape. Our paper here describes a case of erosive arthropathy seen in a prehistoric adult male forager (Witte 3) derived from archaeological deposits associated with the Jacal Rockshelter (41VV674), Val Verde County, Texas. Witte 3 is dated to the Blue Hills Phase of the Late Archaic Period of the Lower Pecos cultural tradition of west Texas. Although this partial skeleton is fragmentary, Witte 3 exhibits severe bilateral EA in the distal forearms, wrists, and hands as well as bilateral ankylosis of numerous joints of the foot. Our examination and subsequent differential diagnosis indicates that these bilateral skeletal lesions are indicative of one of several erosive arthropathies, including rheumatoid arthritis, psoriatic arthritis, and pseudogout. The implications of these lesions and their limitations on individual mobility are discussed within the context of a foraging subsistence economy within the landscape of the Chihuahuan Desert.

Sex-Differentiated Developmental Trajectories and the Role of Mother's Milk

KATIE HINDE

School of Human Evolution & Social Change, Arizona State University, Center for Evolution and Medicine, Arizona State University, Brain, Mind, and Behavior Unit, California National Primate Research Center

Mammalian females pay high energetic costs for reproduction, the greatest of which is imposed by lactation. The synthesis of milk requires, in part, the mobilization of bodily reserves to nourish, protect, and influence developing young. Numerous hypotheses have been advanced to predict how mothers will differentially invest these limited resources in sons and daughters, however few studies have addressed sex-differentiated milk synthesis. Here I will summarize the

evidence for different "biological recipes" in milk produced for sons and daughters in primates, rodentia, cervidae, bovidae, pinnipeds, rodentia, and marsupials. I will further review that even in the absence of different milk compositions produced by mothers, sex-differentiated mechanisms for assimilation of milk constituents may yield sex-differentiated outcomes. To date, fat, protein, mineral, and metabolic hormonal concentrations in milk can be different for or used differently by sons and daughters, whereas the immunofactors of milk show little evidence of sex-differentiation. Collectively these findings suggest that the hormonal signals in breastmilk serve to organize allocation of maternal resources between behavior and growth, tradeoffs that are often differentially prioritized during development by males and females. In contrast, immune protection and entrainment for the mammalian neonate is much less likely to be sexually dimorphic. As such the "food" and "signal" compartments of milk, but not the "medicine" of milk, is more likely to demonstrate signatures of sex-differentiations. Future consideration of progeny-specific adaptations as well as differentiated maternal effort will contribute to a better understanding of the ontogeny of sexual dimorphism.

The role of selection in shaping the cranio-mandibular morphology of *Paranthropus*

NOMAWETHU HLAZO[1,2], TERRENCE R. RITZMAN[2,3,4], LAUREN SCHROEDER[2,5] and REBECCA R. ACKERMANN[1,2]

[1]Archaeology, University of Cape Town, [2]Human Evolution Research Institute, University of Cape Town, [3]Department of Neuroscience, Washington University, St Louis, [4]Department of Anthropology, Washington University, St Louis, [5]Department of Anthropology, University of Toronto Mississauga

Craniodental robusticity in *Paranthropus* has been traditionally interpreted as evidence that the species in this genus share an adaptation to a diet of hard foods. Recent research on craniodental morphology, microwear, biomechanics, and isotopes, by contrast, has suggested that substantial variation exists within *Paranthropus*, both in terms of the ecological niches occupied by the species and the amount of consumed hard and complacent foods. Rather than pointing to a common adaptive suite, these studies suggest that the species were adaptively distinct from each other. However, current approaches to understanding craniodental morphology do not present a clear picture of how these species-specific adaptations differ. It is also not clear whether all aspects of morphology that have been attributed to adaptation are indeed adaptive, rather than the products of non-adaptive processes. This study examines variation in fossil specimens assigned to the three known *Paranthropus* species (*n*=39) using an approach that tests for adaptive morphology against a null hypothesis of random change (i.e. drift). Extant species *(Homo sapiens*, *Gorilla gorilla*, *Pan troglodytes*; n=293) act as analogues for *Paranthropus* variance/covariance. Results reveal a high magnitude of variation within/between species across mandibular/cranial regions, especially when including *P. robustus* from Drimolen. Neutrality tests detect adaptive divergence between *P. robustus* and the other two species, but not between *P. aethiopicus* and *P. boisei*. Reconstructed selection vectors indicate that both positive and negative directional selection have driven diversification in mandibular and tooth dimensions and in the cranium, resulting in variable morphological responses including considerable evidence for correlated selection.

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Mixed signals?: Assessing origins and resistance at the NewYork African Burial Ground

KELLY HOAG[1], JOSEPH L. JONES[1], MICHAEL L. BLAKEY[1] and ALAN H. GOODMAN[2]

[1]Institute for Historical Biology, Department of Anthropology, College of William and Mary, [2]School of Natural Science, Hampshire College

The biocultural study of human remains from the New York African Burial Ground (NYABG) involves determining where African New Yorkers originated and how they resisted enslavement throughout the 18th century. In this study we seek to further refine natality or birthplace estimations for NYABG individuals. Specifically, we compare chemical (strontium isotope ratio and lead concentration) and morphological (cultural modification) data from teeth, revisiting some core assumptions that potentially complicate natality estimations.

Analysis of permanent M1 or I1 teeth revealed general agreement amongst the two biogeochemical methods. Individuals with relatively high $^{87}Sr/^{86}Sr$ ratios above the local (Manhattan) range of 0.711 to 0.712 typically had low lead concentrations (< 1 ug/g), with both values suggesting African natality. The inverse relationship indicated birth in the colonial Americas. However, these patterns do not hold for a small number of individuals (n = 6; 15%) whose chemical profiles and/or culturally-modified teeth provide possibly conflicting evidence of natality.

Dental chemistry and morphology hold continued promise for identifying origins and forced migrants but interpretive challenges remain. The challenge of defining "local" isotopic or chemical landscapes is well known and lessening with time. Other problems are more theoretical in nature. For example, how can we reconcile competing chemical and morphological evidence? Might apparently mixed signals simply represent complexities of lived experience not yet captured through bioarchaeological modeling? We address these questions within a biocultural framework that emphasizes political-economic factors of forced migration and the possibility of cultural resistance in the form of dental modification.

The ontogeny of facial masculinity

CAROLYN R. HODGES-SIMEON[1], SETH M. WEINBERG[2], KYLIE STEINHILBER[1], MICHAEL GURVEN[3] and STEVEN JC. GAULIN[3]

[1]Anthropology, Boston University, [2]Anthropology, University of Pittsburgh, [3]Anthropology`, University of California, Santa Barbara

Facial width-to-height ratio (fWHR) has been proposed as a sexually dimorphic secondary sexual characteristic that develops under the influence of pubertal testosterone. This assumption has motivated studies that reported associations between lower fWHR and elevated levels of aggression, dominance, and risk-taking. It is unclear, however, if fWHR is actually sexually dimorphic. Here we examine two primary research questions: A) are sex differences in fWHR present before, during, and after adolescence? B) If present, are sex differences driven by male and/or female growth? To do so, we measured fWHR, as well as two other previously-proposed facial masculinity ratios (facial width/lower face height and facial width/mandibular width) in two samples of males and females aged 7 to 21 (2D photos of indigenous, Tsimane individuals, N = 154, and 3D scans of US individuals, N = 698). Results showed no evidence of sex differences in fWHR in either sample. In contrast, both facial width/lower face height and facial width/mandibular width showed overall sexual dimorphism, with emergence of these sex differences during adolescence. The present study highlights why research on the timing and pattern of sex differentiation during ontogeny provides valuable information on sexual selection pressures.

Intersectionality and Personhood in Late Woodland Helton Mound 20, Illinois

ALIYA R. HOFF[1], JASON L. KING[2] and JANE E. BUIKSTRA[1]

[1]Center for Bioarchaeological Research, School of Human Evolution and Social Change, Arizona State University, [2]Center for American Archeology

Despite a rich history of bioarchaeological research in the Lower Illinois Valley, previous analyses of past social inequality have not systematically accounted for multiple dimensions of identity, instead privileging one or two axes of social division (e.g., class or gender). Conditions of social life are rarely understood by a single

factor, and an intersectional framework that considers how multiple systems of power affect social position better reflects the complexity and diversity of past experiences. Here we explore the constitution of personhood — the embodiment of intersecting, mutually constructed identities — to inform understandings of lived experience and social change during the Late Woodland (LW) period (ca 1650-1000 BP). We report the results of a holistic bioarchaeological analysis of Helton Mound 20 (Hn20), one of the best excavated Late Woodland sites in the region. Hn20 captures the diversity of LW mortuary practices, including extended mortuary processing and two large multiple burials (MNI 9 and 20). We hypothesize mortuary treatment reflects constitutions of personhood and lived experience that vary across the life course. Osteological analysis of the 83 individuals focused on demography, paleopathology, taphonomic alterations, and biological relatedness via dental phenotypic variation. Results were integrated with mortuary reconstructions and ethnographic sources within an intersectional framework. We report variation in embodied experience and mortuary treatment and discuss the implications of diverse/plural/changing conceptions of personhood in the context of broader systems of LW inequality. This study contributes critical data and a novel theoretical approach to elucidate Late Woodland lifeways in the Lower Illinois Valley.

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A comparison of craniometric methods: Reliability of 3D scanning methods to direct hand-held measurements

MEGAN R. HOFFMAN[1,2] and EMILY E. HAMMERL[2]

[1]Anthropology, University of Indianapolis,
[2]Anthropology, University of Nebraska - Lincoln

Reconstruction of life in past populations is the primary goal in bioarchaeological work, but handling ancient remains is a delicate and sensitive practice. With the growth of 3D imaging technology, the possibility of digital measurement offers a new way to examine irreplaceable materials while preserving a faithful record of the remains. This study examines the error inherent in measuring a 3D model rather than actual remains. We examine the reliability and reproducibility of craniometric measurements taken from 3D models and determine their usefulness in current bioarcheological practice. It is hypothesized that 3D digital measurements are as accurate as direct, hand-held measurements. A total of 6 crania (n=6) at the University of Nebraska, on loan from UC Davis School of Medicine through the Body Donation Program, were studied.The crania were scanned using a NextEngine laser scanner and reconstructed using ScanStudio®. In accordance with standard practice, 24 measurements were taken on both the crania and the 3D models, with digital measurements made using MeshLab®. Results indicate that digital measurements are as accurate as hand-held measurements, supporting 3D measurements as an acceptable means of analysis with the benefit of better preservation practices. With the combined knowledge of traditional biodemography methods and the usefulness of modern, technological identification tools, the field can grow in its accuracy and consistency of morphological scoring.

Childhood stress during the rise of sociopolitical stratification at Colha, northern Belize

KRISTIN K. HOFFMEISTER and LORI E. WRIGHT

Department of Anthropology, Texas A&M University

The Preclassic period (1000 BC-250 AD) was a time of innovation for the ancient Maya that included developments in material culture, writing, mortuary behavior, and social structures. Critically, rising elites gained and consolidated sociopolitical power from the Middle to Late Preclassic. This study uses linear enamel hypoplasias (LEH) to investigate the impact of these sociopolitical shifts on the population of Colha in northern Belize. This study compares the prevalence of LEH and average number of LEH per tooth between time periods at Colha. It also examines LEH differences between Preclassic mortuary contexts to investigate emerging sociopolitical groups.

LEH was macroscopically scored on all permanent teeth at Colha (n=1392). There are significant differences in LEH prevalence between Middle and Late Preclassic periods for maxillary canines (p=0.0046) and several other anterior tooth types. In addition, differences in the average number of LEH per tooth are statistically significant for most tooth types between the Middle Preclassic and other time periods. There are no significant differences in LEH prevalence or the average number of LEH between Preclassic mortuary contexts.

These results provide support for a dramatic shift between the Middle and Late Preclassic that increased the frequency of stress affecting children. Based on associated archaeological evidence, this is likely due to changing sociopolitical structures, although differences between different mortuary contexts in LEH were not detected in this study. Following this transition, there appears to be some stability in the overall stress experiences of children at Colha.

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Preserving Preuss's red colobus (*Piliocolobus preussi*): an analysis of hunting, conservation, and primates in Cameroon

ALEXANDRA N. HOFNER[1], CAROLYN A. JOST ROBINSON[2] and K.A.I. NEKARIS[1]

[1]Anthropology, Oxford Brookes University,
[2]Anthropology, University of North Carolina Wilmington

In conserving nonhuman primates, we must be attuned to the ways in which hunted species are important to human communities as cultural, economic, and nutritional sustenance. Using an ethnoprimatological approach, we use Preuss's red colobus (*Piliocolobus preussi*) as a case study to examine the ways in which changes in primate abundance, livelihood strategies, and local perceptions of nonhuman primates affect the conservation of a Critically Endangered species. Red colobus are highly vulnerable to hunting pressure and early studies report *P. preussi* as one of the most commonly hunted and consumed animals in Korup National Park, Cameroon. We contextualize primate encounter rates from line transect surveys (n = 60.14 km) with ethnographic data from men (n =32) and women (n=31) in a remote village, inside Korup, Ikenge-Bakoko. Our data indicate a low encounter rate *of P. preussi* and decline over time (2004-2005 = 0.05 gp/km to 2016 = 0.02 grp/km). While all adult men extract wildlife from the forest, only 23 or 32 participants identify as a "hunter." We see a disconnect between the externally-conceived understandings of who is a "hunter" and local constructions of identity that impact our ability to monitor primate populations. Consideration of shifting relationships between hunters and prey requires nuanced understanding of the ways in which villagers engage with wildlife, and the income derived from it. Further, we realize the potential of site-specific ethnoprimatological approaches to illustrate the myriad ways that human-primate relationships and attitudes toward conservation are rendered in lived experiences of village residents.

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Secular Trends in Growth in the High-Altitude District of Nuñoa, Peru 1964-2015

MORGAN K. HOKE[1] and THOMAS L. LEATHERMAN[2]

[1]Anthropology, University of Pennsylvania,
[2]Anthropology, University of Massachusetts Amherst

Objectives: Nuñoa, Peru has been the site of anthropological research on human adaptability, growth, and health since the 1960's. Previous studies have documented evidence of a secular trend in growth between initial studies in 1964 and subsequent studies in 1984. A period of sociopolitical upheaval (1982-1992) reduced the trend

during re-examination in 1999. Subsequently, the region has experienced significant economic development reflected in secular trends in height and weight. We evaluate these trends in growth among children over fifty years.

Materials and Methods: Anthropometric data for 929 children collected in 2015 are compared with anthropometric data for 393 children from 1964, 911 children from 1984, and 291 children from 1999. The data were converted to z-scores using the WHO 2007 and 2009 growth standards. Chi-square is used to evaluate whether rates of stunting, overweight, and obesity are significantly different across the study periods.

Results: We observe improved stature and weight, and increasing BMIs from 1964 to 1984. Almost no change in height and a decrease in BMI was observed between 1984 and 1999. Statistically significant reductions in stunting were observed in 2015. Incidence of overweight and obesity diagnosed using BMI were lower in 2015 than in 1984.

Discussion: Elevated BMI's observed in 1984 are explained by reduced stature rather than overweight with skinfold measures indicating that children did not exhibit elevated body fatness. Political stabilization, enhanced infrastructure, and economic expansion contribute to improved economic well-being. Social aid programs and improvements in healthcare distribution have also contributed to improved growth trends.

Support for the most recent wave of data collection was provided by the Wenner Gren Foundation and the Fulbright Hays.

Adverse childhood experiences predict faster reproductive strategies and development

ELIZABETH A. HOLDSWORTH[1] and ALLISON A. APPLETON[2]

[1]Anthropology, [2]Epidemiology & Biostatistics, University at Albany, State University of New York

Within life history theory, a more unstable environment is posited to prompt faster reproductive development and strategies. As life history tradeoffs may be directed by the HPA axis, it is possible that stress early in life may therefore result in earlier reproductive development. However, it is not clear whether this pattern may be present in a well-nourished population and whether this trajectory continues into faster reproductive outcomes and differential reproductive outcomes. This research tests whether adverse childhood experiences predict earlier age at menarche, and whether earlier age at menarche predicts shorter gestation and offspring asymmetric intrauterine growth restriction, indexed by cephalization. The analysis uses data from the Albany Infants and Mothers Study, a prospective study of prenatal exposures and birth outcomes among pregnant women of diverse socioeconomic status in Albany, New York. In a linear regression model of 181 women including covariates of age at report, income during pregnancy, and self-reported race, a greater number of adverse childhood experiences predicted a younger age at menarche (β=-0.13, p=0.02). In additional linear regression models, cephalization at birth and gestational age at birth were predicted by maternal age at menarche (β=-0.013, p=0.01; β=0.15, p<0.05) controlling for infant sex, maternal age, maternal income, self-reported race, smoking during pregnancy, and total number of previous pregnancies. These results indicate an influence of early life stress on faster reproductive trajectories from puberty through adulthood in a well-nourished population. This provides evidence for psychosocial stress developmentally programming reproductive life history traits potentially through alterations to HPA axis development.

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Evidence for maternal buffering of deciduous tooth eruption in Bangladeshi children exposed to famine

DARRYL J. HOLMAN[1,2,3] and BAISHAKHI BASU[1,3,4]

[1]Department of Anthropology, University of Washington, [2]Center for Statistics and the Social Sciences, University of Washington, [3]Center for Studies in Demography and Ecology, University of Washington, [4]Department of Global Health, University of Washington

Tooth development and eruption begin *in utero* and eruption continues postpartum into childhood. Previous research suggests that nutrition can affect the eruption rate of each tooth, but little is known about the susceptibility at different stages of development. For some traits, there is evidence for maternal buffering, in which a fetus is protected from external nutritional stress at a cost to the mother. We examine whether maternal buffering protects a fetus from nutritional stress in deciduous tooth eruption. Emergence times were observed in rural Bangladeshi children (N= 397) born before, *in utero* during, and born after a severe famine. Children were examined monthly for up to 3 years, typically starting from birth. Parametric survival analysis was used to quantify the effects of famine and other covariates on emergence of the 10 left deciduous teeth. Compared to children born after the famine, children who were born up to a year before the famine showed significantly delayed emergence in 6 of the 10 teeth. Children who were *in utero* during the famine exhibited small or no effects of famine on tooth emergence times relative to children born after the famine. The findings suggesting a protective mechanism through maternal buffering.

Who settled Berlin?: Understanding migration through oxygen and strontium isotope analysis

JANE HOLMSTROM[1], KRISTINA KILLGROVE[1], BENJAMIN J. SCHAEFER[2] and BETHANY L. TURNER[2]

[1]Anthropology, University of West Florida, [2]Anthropology, Georgia State University

The foundation of early modern Berlin is largely a historical mystery, as very few documents from the time have survived. However, the recent discovery of a large Medieval cemetery at the site of Petriplatz, allows us to use skeletal remains to estimate the demographic backgrounds of the earliest inhabitants of the city. This study employs oxygen and strontium stable isotope analysis from dental enamel to investigate whether these early Berliners were local to the area or migrants. We conducted stable isotope analysis on a total of 13 adults (8 female, 5 male) dating between the 11th and 13th centuries. Tooth enamel crowns do not remodel once formed; therefore, in an effort to identify individuals who were born locally, first molar enamel was sampled to characterize oxygen and strontium values. The local oxygen ($\delta^{18}O$) range is -5.4‰ to -3.8‰, and the local strontium ($^{87}Sr/^{86}Sr$) range is 0.7100 to 0.7110. This investigation yielded six potential immigrants who moved to Berlin during or after childhood, as their oxygen and strontium isotope signatures are outside the local range.

This is the first study using biochemical analysis to estimate migration and demographic variation in the nascence of a major European capital. Archaeological and bioarchaeological research is imperative for understanding the formative years of early modern Berlin. This research therefore shows that using a multidisciplinary approach to examine the past can yield new and exciting information.

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Chimpanzee plantar pressure distributions and the evolution of bipedal plantigrady

NICHOLAS B. HOLOWKA[1], KEVIN G. HATALA[2,3], BRIGITTE DEMES[4], NATHAN E. THOMPSON[5] and ROSHNA E. WUNDERLICH[6]

[1]Department of Human Evolutionary Biology, Harvard University, [2]Department of Biology, Chatham University, [3]Center for the Advanced Study of Human Paleobiology, George Washington University, [4]Department of Anatomical Sciences, Stony Brook University Medical Center, [5]Department of Anatomy, NYIT College Osteopathic Medicine, [6]Department of Biology, James Madison University

Chimpanzees are our closest living relatives and display many postcranial similarities to the earliest known fossil hominins, making the species an informative experimental model for studying the evolution of hominin bipedal

locomotion. Opportunities to study chimpanzee locomotion in laboratories are disappearing, making researchers increasingly reliant on zoos and other less-controlled captive settings to collect gait data. Recently, several studies carried out in these conditions have used pressure-sensing technology to assess foot biomechanics during locomotion. However, 3-D kinematic data are very difficult to collect in non-laboratory settings, and thus these studies have been unable to determine how plantar pressure data related to intrinsic foot joint motion. Here we measured plantar pressure distributions in four and 3-D foot kinematics in two male chimpanzees during bipedal and quadrupedal locomotion on a flat runway, and compared our findings to similar data collected from humans. In preliminary analyses of bipedal steps, we found positive associations between midfoot dorsiflexion and lateral midfoot pressure peaks, as well as between peak metatarsophalangeal joint dorsiflexion angles and metatarsal head pressures, suggesting that pressure data can be used to make inferences about foot kinematics in non-human apes. Based on pressure data from a total of four chimpanzees we also found that, contrary to some previous descriptions of *Pan* plantar pressures, our subjects exhibited center-of-pressure paths through the middle of the midfoot region, as well as lateral-to-medial roll-off patterns across the metatarsal heads during push-off, like humans. These findings reveal underappreciated similarities in the bipedal foot mechanics of humans and chimpanzees.

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Limb bone diaphyseal structure reflects population relationships in a pan-European sample

BRIGITTE HOLT[1] and GINA AGOSTINI[2]

[1]Anthropology, University of Massachusetts, [2]Obesity Solutions Initiative, Mayo Clinic, Arizona State University

While cranial morphology clearly reflects neutral evolutionary forces and population history, long bone structure exhibits more sensitivity to mechanical loads. This is supported by numerous studies on archeological and clinical/athlete samples, most of which focus on populations that engage in vigorous physical activity (e.g., long distance mobility and non-mechanized agriculture) where mechanical loads are *expected* to have modified limb bone structure. But with greater reliance upon mechanized transport and increasingly sedentary lifestyles in recent decades, the degree to which long bone structure may also reflect underlying genetic factors is important. We explored whether diaphyseal structure could reflect geographic structure across 30 northern and southern Europe populations (724 individuals) spanning Medieval to 20th century (800 -1950 AD). We used size-standardized variables reflecting diaphyseal shape and robusticity. A Relethford-Blangero population genetic model was used to generate a matrix of pairwise distances that were then plotted using multidimensional scaling to assess the presence of temporal and/or geographical structure.

Most samples form clear geographical clusters, suggesting that long bone morphology can reflect population history. Italian samples, however, do not cluster well, a fact that may reflect regional isolation. One outlier, Sassari (Sardinia), is particularly interesting, as genetic studies have long confirmed a strong degree of genetic isolation among populations here. Also interesting is Medieval Vicenne, another outlier, as this site reflects a population whose unique archeological record and burial style indicate strong cultural ties to extra-local, multiethnic Eurasians. Results confirm diaphyseal variation can reflect among-population relationships consistent with an isolation-by-distance neutral model.

The ontogeny of variability in the modern human masticatory apparatus

NATHAN E. HOLTON[1], AMANDA PICHE[2] and JILL E. SCOTT[3]

[1]Orthodontics, The University of Iowa, [2]College of Dentistry, The University of Iowa, [3]Department of Anthropology and Sociology, Metropolitan State University of Denver

Is the magnitude of size and shape variability of the adult modern human masticatory apparatus a reflection of early developmental variation, or does variability gradually increase as a result of masticatory loading? Addressing this question is key to understanding the extent to which the masticatory morphology is a reflection of functional vs. non-functional influences. Currently, we lack data regarding the ontogeny of masticatory variability in modern humans. Using a geometric morphometric approach, we tested the null hypothesis that there is no difference in the magnitude of size and shape variation in the developing masticatory apparatus using the Iowa Facial Growth Study. We collected a series of maxillary and mandibular landmarks from longitudinal lateral cephalograms of n=63 subjects at age 4yrs, 11yrs, and adulthood. To account for the increasing effects of sexual dimorphism, we corrected for within age group allometry. First, we tested for homogeneity of variances in centroid size across age groups. Next, to assess the magnitude of shape variation, we tested for significant differences using the trace of variance-covariance matrices for each group. There was no significant difference in the magnitude of shape variation from 4yrs–11yrs (p=0.97); however, shape variation significantly increased from 11yrs–adulthood (p<0.01). With regard to size variation, there was greater variability in the adult sample; however, there was no significant difference among age groups (p=0.08). Thus, our results indicate that variability in mandibular shape increases during ontogeny, while the magnitude of size variation is maintained during development.

Pre-contact and historic era *Mycobacterium tuberculosis* complex genomes from the Americas

TANVI P. HONAP[1], ÅSHILD J. VÅGENE[2], ALEXANDER HERBIG[2], MICHAEL S. ROSENBERG[3], JANE E. BUIKSTRA[4], KIRSTEN I. BOS[2], JOHANNES KRAUSE[2] and ANNE C. STONE[4,5]

[1]Department of Anthropology, University of Oklahoma, Norman, USA, [2]Department of Archaeogenetics, Max Planck Institute for the Science of Human History, Jena, Germany, [3]School of Life Sciences, Arizona State University, Tempe, USA, [4]School of Human Evolution and Social Change, Arizona State University, Tempe, USA, [5]Center for Evolution and Medicine, Arizona State University, Tempe, USA

Tuberculosis (TB) is one of the oldest human diseases and is caused by bacteria belonging to the *Mycobacterium tuberculosis* complex (MTBC). While TB is thought to have originated in Africa and spread across the Old World due to human population movements, how it was introduced to the New World has been a matter of debate. Skeletal evidence suggests that TB was present in the Americas prior to the arrival of Europeans; however, the pre-contact era MTBC strains were completely replaced by more virulent European-origin MTBC strains during the Age of Exploration. Previous research from our group found that pre-contact era human populations from the Osmore River Valley in coastal Peru were infected with MTBC strains similar to those currently found in pinnipeds such as seals and sea lions. Thus, consumption and/or handling of infected pinnipeds served as an avenue for transmission of TB in the past. In the current study, we screened 70 individuals from various archaeological contexts in the Americas. We recovered MTBC genomes from three pre-contact era individuals residing in non-coastal locations in Peru and Colombia as well as from a mid-19th century individual from New York, USA. The presence of strains belonging to the pinniped-derived MTBC lineage in non-coastal populations suggests that these strains were not limited to coastal populations but also spread to human populations residing in other parts of the Americas. We also show that European-origin H37Rv-like strains were present in the USA by the mid-19th century.

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Associations between sexually dimorphic skeletal traits and body size: An exploratory multivariate analysis

HALEY E. HORBALY

Anthropology, University of Tennessee, Knoxville

Sexual dimorphism in the human skeleton has been studied by identifying associations between morphological trait expression and sex, yet how these traits associate with each other has largely been ignored. A previous study testing whether individual morphological trait expression is linked to body size parameters found significant, yet weak, associations, with stature explaining more relative variance in trait expression than body mass. Here, a multivariate approach is taken to simultaneously explore associations among sexually dimorphic traits and body size. Sex-specific multiple correspondence analyses (MCA) were conducted on morphological sex estimation trait scores and body size parameter quartiles for a sample of 209 white adult skeletons (n female = 100; n male = 109). MCA results show only weak associations within the dataset, with the first two dimensions only explaining between 5.87% and 7.19% of the data's variance for both sexes. Nonetheless, some relevant patterns were observed: Stature in both sexes, and body mass for females, have their extreme values separated on the plot with low trait scores clustering near the shortest quartile and high scores near the tallest quartile, reinforcing patterns described in the previous study. However, body mass is not logically organized for males, with both the extreme quartiles clustering together, suggesting nonlinear relationships. In combination with the previous univariate analyses, the multivariate analyses permit the identification of more complex patterns of association between variables, highlighting the complex nature of the biological variation tied to sexual dimorphism in the human skeleton.

Nutrition and diet of a Late Medieval Prussian population: What the analysis of dental microwear can tell us

JENNA HORVAT[1], MARISSA RAMSIER[1], ARIEL GRUENTHAL-RANKIN[1,2], ARKADIUSZ KOPERKIEWICZ[3] and MAREK POLCYN[4]

[1]Department of Anthropology, Humboldt State University, [2]Department of Anthropology, Binghamton University, [3]Institute of Archaeology, University of Gdansk, [4]Department of Anthropology, Lakehead University

This study utilized dental microwear to analyze dietary patterns of individuals from the Late Medieval (mid 14th-15th century) Old Prussian cemetery in Bezławki, Poland. Data were gathered in conjunction with the 2017 Bezławki Bioarchaeology Field School and included 53 individuals (19 subadults, 15 adult females, 19 adult males) excavated between 2010-2017. For each individual, dental impressions were made of mandibular and/or maxillary first and second molars on-site, which were later used to make epoxy casts. Dental microwear analysis of the casts was accomplished using two types of microscopes: a scanning electron microscope (for a more traditional microwear analysis) and a Sensofar Plμ white-light scanning confocal microscope (to accomplish dental microwear texture analysis). The microscopes yielded similar results, with benefits of the scanning electron microscope analysis including that it was cost-effective and the equipment was readily available. The confocal microscope, on the other hand, yielded a different level of detail and was more objective. Overall, the results indicated that the individuals at Bezławki were eating a somewhat varied diet likely including substantial quantities of meats and grains, with some variation across individuals. This study contributes to a more nuanced picture of how diet, nutrition, and metabolic stress may have differentially affected regional populations and demographic groups in Medieval Europe and how the dentition may be analyzed using multiple methods of dental microwear analysis.

Evolutionary implications of primate skeletal DNA methylation patterns and their relationship to skeletal phenotypes

GENEVIEVE HOUSMAN[1,2,3], ELLEN E. QUILLEN[4] and ANNE C. STONE[2,3]

[1]Section of Genetic Medicine, The University of Chicago, [2]School of Human Evolution and Social Change, Arizona State University, [3]Center for Evolution and Medicine, Arizona State University, [4]Department of Genetics, Texas Biomedical Research Institute

Epigenetic mechanisms play crucial roles in the expression of diverse phenotypes within and between species. In primates, DNA methylation patterns have been associated with phylogenetic, behavioral, and disease-related phenotypes. However, such research has primarily focused on soft tissues. The current study expands on this exploratory work by assessing the evolutionary relationship of DNA methylation in primate skeletal tissues and examining how this variation relates to aspects of skeletal development and maintenance. Methylation patterns were assessed in femoral bone and cartilage from baboons (n=56), macaques (n=10), vervets (n=10), chimpanzees (n=4), and marmosets (n=6) using Infinium MethylationEPIC arrays. Nonpathological femur morphologies (n=29) were measured among species, and the degree of osteoarthritis, a disorder characterized by the breakdown of bone and cartilage, was assessed within baboons. From a phylogenetic perspective, we found that 1.63% of the 39,802 sites examined show species-specific methylation patterns in baboons, 0.65% in macaques, 1.61% in vervets, 7.02% in chimpanzees, and 34.62% in marmosets. However, methylation variation is not related to morphological variation. Conversely, several methylation changes are associated with the occurrence of osteoarthritis in baboons. Specifically, 0.20% of 191,570 sites examined show osteoarthritis-related methylation patterns in bone tissues and 11.16% in cartilage tissues. Additionally, several of these osteoarthritis-related changes are conserved with those known in humans. Overall, these findings reveal that while methylation variation in skeletal tissues is not strongly related to nonpathological skeletal morphology differences, it is correlated with the development of osteoarthritis and may provide insight into skeletal disease evolution across primates.

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Zika Virus and maternal stigmatization: Supporting maternal and child health through religious engagement in American Samoa

MICHAELA E. HOWELLS[1] and CHRISTOPHER D. LYNN[2]

[1]Anthropology, University of North Carolina Wilmington, [2]Anthropology, University of Alabama

In many communities around the world, religion plays a central role in public education. Perceptions of inherent conflicts between scientific and religious authorities inform attitudes about the trustworthiness of science, which can ultimately influence access to and utilization of healthcare. Support from, and active collaboration with, religious institutions and leaders can therefore be vital in effective community health management. In this paper, we discuss Zika Virus in American Samoa, a heavily missionized US territory. Vertical transmission of Zika between mother and fetus can have dire consequences, including microcephaly and significant hearing and vision deficits. The CDC has recommended preventative education during prenatal care visits and access to preventative measures (e.g. insect repellant, condoms) early in pregnancy as keys to preventing Zika transmission. However, reproductive health is not part of school curricula in American Samoa, and premarital pregnancy is stigmatized. Consequently, unmarried mothers begin their prenatal care later and attend fewer appointments, reducing their access to Zika education, testing, and preventative measures. We explore how Zika prevention and treatment lies at the intersection of (1) cultural (including religious) competency in visiting public health providers, (2) religious perspectives on the timing of prenatal care (3) religious perceptions of sexual health education and access to family planning. Increasing dialogues between religious groups and scientists can improve community

education and reduce health disparities. In this paper we discuss the role of biological anthropologists in constructive engagement with religious leaders, and recognize their role as potential gatekeepers, stakeholders and community allies.

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Comparison of RNA stabilization methods in samples collected from the Democratic Republic of Congo

CHU HSIAO[1,2,3], JACKLYN QUINLAN[4] and CONNIE MULLIGAN[1,2]

[1]Dept of Anthropology, University of Florida, [2]Genetics Institute, University of Florida, [3]College of Medicine, University of Florida, [4]Immigration, réfugiés et citoyenneté Canada, Ottawa, Ontario, Canada

Anthropologists have long been interested in human adaptation to a diverse range of environmental stressors. Epigenetic modifications and resultant changes in gene expression are one possible mechanism underlying adaptation. However, RNA preparation for gene expression studies requires great care to avoid degradation and ensure transcript integrity and abundance for running downstream applications. Careful preparation is further complicated by the nature of many anthropological studies where samples are often collected in the field with limited access to liquid nitrogen and -80°C freezers.

Two methods conducive to field collection were used to collect whole blood samples from new mothers and their newborns at HEAL Africa Hospital in the eastern Democratic Republic of Congo. All samples were collected in a clinical setting and immediately stabilized (in RNA*later*™Stabilizing Solution and in Tempus™ Blood RNA Tubes), frozen, and transported to Gainesville, Florida for RNA extraction. In the first method, samples were mixed in RNA*later* solution to prevent RNA degradation without lysing cells and extracted using the RiboPure RNA Purification kit. In the second method, samples were collected in Tempus tubes to immediately lyse the cells and inactivate RNases and RNA was extracted using the Tempus™ Spin Isolation kit. Blood samples from 12 mother-newborn dyads were preserved and extracted using both methods. Differences between the methods were tested for RNA yield and purity based on RNA Integrity Numbers and 260/280 ratios. We demonstrate which protocols should be used for optimal RNA preservation thereby progressing the field towards utilizing the transcriptome to better understand human adaptations.

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Genomic areas associated with MZ twinning differ from those associated with DZ twinning

HONG HUANG[1], KATHRYN B.H. CLANCY[2], KILIAN KELLY[3] and LORENA MADRIGAL[4]

[1]School of Information, University of South Florida, [2]Department of Anthropology and Beckman Institute of Advanced Science & Technology, University of Illinois at Urbana-Champaign, [3]Anthropology, University of South Florida, [4]Anthropology, University of South Florida

Researchers interested in the genetic bases of human twinning assumed that dizygotic twinning (DZ) is under genetic predisposition, since monozygotic twinning (MZ) is presumably a teratogenic event due to the splitting of one fertilized egg. However, reports of familial-MZ-twinning exist. We use data-mining methods to identify SNPs that differ between a set of MZ and DZ twins. We obtained data from the Whole Genome Association Twin Study of Myopia and Glaucoma Risk Factors. Samples are n=1223 MZ pairs and n=1655 DZ pairs. Of the SNPs listed as relevant for establishing zygosity by Hannelius, et al. 2007, 24 were found in this data set and based on the literature, four were found to be significant. After Bonferroni correction, one was significant, namely the rs17407 SNP in the Xq27.2 region. DZ and MZ twin groups differ significantly for both genotypic (GG vs AA) and allelic (G vs A) frequencies. The odds of finding the AA genotype are lower in MZ rather than DZ twins (OR=0.77, 95%CI=0.63-0.94; p=0.006). The Xq27.2 region contains two tightly linked gene clusters, namely SPANX and MAGEC, which are expressed in the testes and are necessary for the formation of mature spermatozoa. These results indicate that paternal factors affecting the integrity of the fertilized egg are involved in familial MZ twinning and that genetic bases of MZ and DZ twinning are different. If natural selection acts on differential fertility via twinning it may do so via different genetic systems and via maternal and paternal lines.

Assessing methods for estimating linear enamel hypoplasia prevalence in the field: implications for bioarchaeological practice

AMELIA R. HUBBARD[1], GIUSEPPE VERCELLOTTI[2], HEDY M. JUSTUS[2] and AMANDA M. AGNEW[2,3]

[1]Department of Sociology and Anthropology, Wright State University, [2]Department of Anthropology, The Ohio State University, [3]Skeletal Biology Research Lab, The Ohio State University

Studies of linear enamel hyploplasia (LEH) have become ubiquitous in the literature and synonymous with studies of "health" and quality of life among archaeological assemblages. Yet, there are a number of methods employed by bioarchaeologists in the field for the assessment and quantification of linear enamel hypoplasia (LEH) prevalence, with the potential to over or underestimate LEH prevalence at such sites. These methods range from "feeling" defects with one's fingernail (i.e., the "fingernail test") to macroscopic observations using a hand lens. Further complicating such analyses is the fact that not all approaches examine "systemic" defects (i.e., where LEH are viewed on antimeric pairs). This study compares LEH prevalence estimates using two common methods: 1) the "fingernail test" popularized by the Global Health project, and 2) macroscopic evaluation of dental replicas.

Frequency counts were estimated for 56 individuals, using data collected from dental remains and replicas from a Medieval site in Giecz, Poland (Gz4). Both systemic and non-systemic defect counts were collected and compared between methods. Preliminary results indicate that, compared to macroscopic methods, the "fingernail test" consistently overestimated (97 percent of cases) prevalence of LEH. When the systemic nature of LEH was considered counts were still consistently higher (93 percent) for the "fingernail test." Paired t-tests showed consistently statistically significant differences in the reported prevalence of LEH for both non-systemic ($t=11.95$, $p < 0.0001$) and systemic ($t=8.85$, $p < 0.0001$) defects. Such results underscore the importance of testing commonly used methods in field settings to insure reliable data.

A longitudinal study of the correspondence of non-metric traits in mixed human dentitions: insights from the Stucklen dental molds

ELLIOT D. HUBBARD[1], LARESA L. DERN[1], PHILIPPE ATALLAH[2], MICHELLE M. GLANTZ[1] and JANET M. MONGE[2]

[1]Department of Anthropology, Colorado State University, [2]Museum of Anthropology and Archaeology, University of Pennsylvania

Non-metric variation in the permanent dentition is commonly assumed to be the reflection of underlying genetic variation related to growth and development. While the degree to which traits correspond in the permanent and deciduous teeth of a single individual may lend support to this notion, the relationship is not fully established. This study considers a unique collection of dental molds taken in the mid- 20th century by Dr. Richard H. Stucklen and housed at the University of Pennsylvania Museum of Anthropology and Archaeology. Dr. Stucklen made a series of molds on individual patients from birth to age 27, in 6 to 12 month intervals. The sample (n=53) effectively captures the entire eruption sequence and provides the necessary longitudinal data for intra-individual comparison of non-metric expression. Using the Arizona State University Dental Anthropology System, 25 non-metric traits in baby and adult teeth were scored for each individual. These data were analyzed using Goodman and Kruskal's Gamma correlation and

tetrachoric correlation to test the null hypothesis that no significant correlation exists in the expression of non-metric traits among baby and adult teeth within the same individual and across the sample. Our results suggest, however, in those individuals who express non-metric traits, such as Carabelli's cusp, some aspects of shoveling, the presence of anterior fovea, and the mid-trigonid crest, the traits are correlated. Thus, non-metric traits may share a similar genetic basis in both the deciduous and permanent dentition. To elaborate on these implications, field and clone theory are discussed.

Extending the adaptive landscape metaphor into bioarchaeological theory and practice

MARK HUBBE[1,2] and COLLEEN CHEVERKO[1]

[1]Department of Anthropology, Ohio State University, [2]Instituto de Arqueología y Antropología, Universidad Católica del Norte

The biocultural synthesis, as defined in the late 1990s by Goodman and Leatherman, argues for a more inclusive discussion of how social, cultural, political, and economic factors interact with biology. Within Bioarchaeology, this approach has become a mainstream model to the study and interpretation of the past. In this paper we situate the biocultural approach within Wright's adaptive landscape metaphor to better comprehend the nature of the interaction between biological and cultural systems in past human societies. To exemplify the importance of this discussion, we analyze the biocultural interpretation of two case studies: Tiwanaku influence on oral health in the Atacama oases in Chile and activity patterns in the delta region of California during the Late Holocene. Both case studies show conflicting interpretations of data, based on different perspectives of the role of cultural and biological phenomena. The inclusion of the extended adaptive landscape metaphor into both of these case studies allow us to reconcile the conflicting interpretations, by highlighting the place where biology and culture interact in each. To situate the interpretations from these case studies into the bioarchaeological literature, we compiled information on how the biocultural context was used in over 100 articles from mainstream anthropological journals since 2000. The literature review demonstrates a divide in the use of biological, cultural, and environmental factors to explain discontinuities observed in regional and diachronic comparative studies, with little discussion of the assumptions behind these factors. Consequently, the effective use of the biocultural approach requires constructing a more cohesive explanatory framework.

Sexual dimorphism and regional variation in the pectoral and pelvic girdles of modern humans

DAPHNE HUDSON[1,2], JOHN H. LANGDON[2] and STEPHEN P. NAWROCKI[2]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [2]Human Biology Program, University of Indianapolis

Among modern humans, it has been qualitatively observed that broad shoulders and narrow hips and waists produce a triangular body shape in males, while smaller waists relative to shoulders and hips produce an "hour-glass" shape in females. Anthropometric studies of living populations, and osteological examinations of archaeological and modern populations, report both geographical variation and sexual dimorphism in the pectoral and pelvic girdles. Arguments citing obstetric demands and biomechanical constraints (for the pelvic girdle) and intrasexual competition (for the pectoral girdle) have been proposed to explain these sex differences. However, one foundational issue is that most previous analyses have not first considered whether the observed shape differences exist independent of body size. This study compares size-adjusted measures of the pectoral and pelvic girdles and various pectoral-pelvic indices among individuals of European and native South African descent to explore how trunk shape differs according to sex and geographic ancestry. Analysis of covariance demonstrates that sexual dimorphism and geographical variation exists for the scapula, clavicle, pubis, and sacrum, as well as for several of the pectoral-pelvic indices, after size adjustments. These results conform to those previously published on absolute size dimorphism, and expand our knowledge of which regions in the body may vary among individuals after adjusting for size and how they vary. Future work will explore how trunk shape is influenced by obstetric requirements, intrasexual competition, ecogeographic variables, and drift in the features identified here by extending analyses to extant non-human primates and extinct hominins.

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Compatibility of Ancestry Composition Estimations of Forensic STR loci *versus* Ancestry Informative Markers

CRIS E. HUGHES[1] and BRIDGET FB. ALGEE-HEWITT[2]

[1]Anthropology, University of Illinois at Urbana-Champaign, [2]Biology, Stanford University

While small sets of forensic STR loci (F-STR) have been used to reveal latent structure, estimate ancestry, or generate proportions of admixture, the appropriateness of these applications using such markers has not been thoroughly studied. Our goal is to determine the compatibility of admixture estimates generated from F-STR and gold-standard ancestry informative (AIMs) panels, using Latin American samples representing a wide range of ancestry proportions.

We compare the ancestry proportions obtained using F-STR and AIMs data, drawn from the *same* individuals. Parallel STRUCTURE analyses were run for both datasets, investigating K=2 and 3 solutions that included Native American, European and African parental populations. The consensus solutions for both panels were obtained and subjected to analysis. The similarity statistic computed between these two panels is high (0.86). The correlations between the matched ancestry components are strongly positive and significant when samples are partitioned by subpopulation (ρ=0.66-0.96, p<0.001). The classification error for hard-cluster assignments is low (4.24%).

The use of F-STRs for di- or trihybrid ancestry estimation has important implications for forensic anthropology. F-STR profiles often represent the only source of genetic information available for understudied populations, especially in the forensic casework context. In addition to the skeleton, they provide the forensic practitioner another source of information on ancestry. If ancestry estimates from F-STRs are reliable approximations, then comparisons between skeletal (nonmetric and metric) and genetic (F-STR) estimates of ancestry can be made for a larger pool of samples, to better understand the relationship between these two biological systems.

Multiscale Investigation of human variation in skeletal health

RANDEE L. HUNTER[1], KAREN C. BRILEY[2], JAMES ELLIS[2] and AMANDA M. AGNEW[1]

[1]Skeletal Biology Research Laboratory, The Ohio State University, [2]Wright Center of Innovation in Biomedical Imaging, The Ohio State University

The skeletal system, as a dynamic record incorporating both intrinsic and extrinsic influences, provides a multiscale history of the combined local mechanical and systemic environments of the individual to which it belonged. Thus, understanding variation in parameters of skeletal health requires a multiscalar approach (inter-individual, intra-individual, and intra-element). High-resolution quantitative computed tomography (HR-QCT) was performed on *ex vivo* bilateral tibiae and radii from a cadaveric sample of 70 males (63.7±14.1 years) and 30 females (64.4±14.4 years). Volumetric bone mineral density (vBMD), cortical area (Ct.Ar), robustness (Ct.Ar/Le), section modulus (Z), and bone stress-strain index (SSI) were measured at multiple segment sites along the length of the weight bearing tibia (38%,50%,66%) and non-weight bearing radius (30%,50%). Sexual dimorphism was demonstrated in both elements (p<0.05). Linear regressions indicate the inability

of age or body size to predict any parameter of skeletal health in the radius ($p>0.05$) but were weakly related to vBMD and robustness in the tibia ($p<0.05$). Intra-individual investigations quantified significant side differences in both elements ($p<0.01$) in all parameters except vBMD. Correlations between SSI in the tibia and radius indicate some level of systemic control despite differences in mechanical environment. Lastly, the pattern of co-variation in cross-sectional properties (Ct.Ar and Z) and vBMD indicate similar intra-element relationships between amount/distribution of bone and mineralization. Each skeletal element adapts to a combination of its systemic and mechanical environments thus promoting a hierarchical perspective that considers multiscale sources of variation in the skeletal health of past and present populations.

The endocast of LES1, *Homo naledi*

SHAWN D. HURST[1], RALPH L. HOLLOWAY[2], HEATHER M. GARVIN[3], WILLIAM B. VANTI[4], JOHN HAWKS[5] and LEE R. BERGER[6]

[1]Anthropology, Indiana University, [2]Anthropology, Columbia University, [3]Anatomy, Des Moines University, [4]Science and Engineering Library, Columbia University, [5]Anthropology, University of Wisconsin-Madison, [6]Evolutionary Studies Institute and Centre of Excellence in PalaeoSciences, University of the Witwatersrand

Due to the poor preservation of many hominid endocranial surfaces in general and the *pars orbitalis* of the frontal bone in particular, the evolution of human frontal lobe morphology is not well understood. Here we show the *Homo naledi* LES1 fossil skull, recently discovered in the Lesedi chamber of the Rising Star cave system, South Africa, provides an endocast with an unusual degree of ventral frontal morphological detail not preserved in other *Homo naledi* endocrania. Unlike the DH3 endocast, in which the lateral frontal sulcal morphology is clearly defined, LES1 has well-preserved lateral orbital sulcal morphology with modern-like characteristics. The LES1 endocast provides further evidence that *Homo naledi* had derived *Homo*-like frontal brain organization despite its relatively small endocranial size (610 cc) and that larger brain size is not a co-requisite to modern-like brain organization. Depending on the phylogenetic position of *Homo naledi,* this may also indicate that brain reorganization preceded brain size increase during human evolution.

Funding for excavation and analysis was provided by the National Geographic Society, National Research Foundation of South Africa, and the Lyda Hill Foundation.

The lost children of St Augustine, Bristol, UK: A Study of commingled remains

SHIYLAH K. HUSSAIN

Faculty of Science and Technology, Bournemouth University

Often, juvenile skeletal remains are neglected due to the common preconception that they are unable to provide meaningful information. Excavations between June 1983 and July 1984 in St Augustine in Bristol, England (UK) uncovered a large amount of disarticulated and commingled remains which had not previously been studied until now. This study focuses on the analysis of commingled juvenile remains to give greater insight into the lives of the children and to understand the extent to which they developed and lived differently to modern children. The initial hypothesis suggests that the childrens ages would coincide with typical weaning ages (3 – 5.5 years).

The collection comprised of unsorted commingled remains and the minimum number of individuals (MNI) was unknown. In order to establish the MNI, the traditional MNI method was applied. Radiographs of mandibles were taken to accurately assess the development of dentition and whether biological and chronological age differed. Sexing was attempted using the shape of the pelvis and mandible. A paleopathological examination was carried out to determine the presence of disease which may indicate the cause of death. Results indicated that there were at least 15 children represented in the collection, with a large age range from 31 prenatal weeks to 24 years. The most frequent age group being 3 years – 5.5 years. There were only two potential signs of disease visible– Genu Valgum and a dentigerous cyst. Interestingly, the results provided a platform to further investigate the younger children in future studies.

State of knowledge on chimpanzee ecology and behavior in the unprotected zone of Diaguiri (Kédougou, Sénégal)

PAPA IBNOU. NDIAYE[1], STACY M. LINDSHIELD[2], LANDING BADJI[1] and JILL D. PRUETZ[3]

[1]Département de Biologie Animale, Cheikh Anta Diop University, [2]University de Perdue, USA, [3]University of Texas, USA

The northwestern limit of the West African Chimpanzee range (*Pan troglodytes verus*) is located within the Kédougou region of Senegal. Chimpanzees at Diaguiri (UTM Zone 28N: 823230 E, 1396425 N) occupy a periurban environment about 30 kilometers from the city of Kedougou. There is an urgent need to conserve and manage these critically endangered apes given that urbanization and human population size are concomitantly increasing with the gold mining industry in Senegal. However, there is a lack of information about the ecology and behavior of periurban savanna chimpanzees. Since March 2015, we have studied the Diaguiri chimpanzees in order to estimate community size, community home range, and nesting behavior. Our methods included unstructured interviews of local residents, reconnaissance walks, and camera traps. We surveyed 43 km within a 68 km^2 area. The Diaguiri community consists of a minimum of 11 individuals, including two immature individuals. We recorded 871 chimpanzee nests supported within 17 tree species. The most common nesting tree species were Pterocarpus erinaceus (26.1%), *Anogeissus leiocarpus* (19.1%), *Diospyros mespiliformis* (13.6%), *Khaya senegalensis* (10.3%), and *Hexalobus monopetalus* (9.4%). We will discuss how these results can inform management planning for regional timber extraction permits.

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Secular change in Croatian male crania: 1812-1973

ILEANA ILAS[1], RICHARD L. JANTZ[1], DOUGLAS OWSLEY[2] and MARIO ŠLAUS[3]

[1]Anthropology, University of Tennessee, [2]Anthropology, Smithsonian Natural Museum of Natural History, [3]Archaeology, Croatian Academy of Sciences and Arts

Several studies on various global populations, including American Whites and Blacks, Portuguese, and Japanese have shown significant secular change in cranial dimensions, and have attributed these changes to environmental factors, such as diet and medical care. Generally, the cranial vault has increased in height and decreased in breadth. This study hopes to expand on existing literature by investigating cranial secular change within the Croatian population. We hypothesize that significant differences exist in cranial dimensions between earlier-born and later-born Croatians, with those born more recently following the global trend of narrower cranial breadth and larger cranial height than their predecessors.

To address this, the crania of 141 male Croatians born between 1812 and 1973 were analyzed. Five cranial vault variables were examined: maximum cranial length, maximum cranial breadth, basion-bregma height, basion-nasion length, and auricular breadth. Individuals were divided into cohorts of 25 years, beginning with the year 1800, and ANOVAs were conducted on each variable with respect to cohort. Basion-bregma height, basion-nasion length, and maximum cranial breadth were shown to undergo significant ($p < 0.05$) temporal change, with group means for these three dimensions increasing over time.

These results show that there has been a significant change in Croatian cranial dimensions over the past two centuries. However, some of these changes, such as the increase in cranial breadth, differ from other populations, suggesting that Croatians might have undergone slightly different environmental processes during this time period.

Dental signs attributed to congenital syphilis and its treatments in the Hamann-Todd Skeletal Collection

STELLA IOANNOU and MACIEJ HENNEBERG

Biological Anthropology and Comparative Anatomy Research Unit, University of Adelaide

The prevalence of syphilis in the United States during the 1800s and early 1900s was high, causing concern to health officials. Various measures were taken to control its spread, including the use of mercuric treatments.

The purpose of this study is to determine whether dental abnormalities related to congenital syphilis (CS) occur in individuals who died of syphilis or syphilis-related causes in the Hamman Todd Osteological Collection, and whether mercurial treatment was used.

Dental abnormalities in untreated and treated patients with CS described by Hutchinson, Moon and Fournier, and Hillson's standardized dental descriptions associated with CS were used as criteria. In the Hamman Todd Osteological Collection in Cleveland, Ohio, 102 individuals had a cause of death recorded in the catalogue as syphilis or lues, while 69 had causes of death related to syphilis: paresis (53), aortic insufficiency (15) and pericarditis (1). Dentition of these 171 individuals was examined to determine if dental abnormalities associated with CS and its treatments were present even though no congenital disease was specified. Crania were examined for any bone pathologies.

Individual (2266) demonstrated dental malformations possibly related to CS itself. Three others demonstrated dental abnormalities associated with mercuric treatments, (2118, 2263 and 3097). No bone pathologies were evident on skulls of these individuals.

The use of pre-penicillin treatments of CS may have been effective to maintain health into adulthood but not always in eradicating the infection. Effects of mercury on amelogenesis need to be considered when making a differential diagnosis of CS.

Variation in the musculo-skeletal configuration of the skull and the the evolution of bite performance in primates

JOSE IRIARTE-DIAZ, HANI ZANO and YANA BUSHNEVA

Oral Biology, University of Illinois at Chicago

Variation in the structural relationships within the masticatory system through the evolutionary history of mammals has greatly influenced the mechanical performance of the system. These changes are viewed as evolutionary responses associated to specific pressures; such as the need to generate occlusal force, to resist masticatory stresses, or for delicate motor control. Thus, variation in the musculo-skeletal configuration are expected to reflect adaptations to these competing and varying demands. To evaluate the relative importance of these elements in shaping the evolution of the masticatory system necessitates adequate understanding of how variation in each factor affects the mechanical performance of the system as a whole. Using 3D models of the cranium and mandibles from 69 species of primates, we evaluated how variation in jaw muscles size and position affect bite performance within an ecological and phylogenetic framework. In addition, we modelled the effect of gape angle and condylar translation on muscle strain and muscle moment arms, as well as the effect of the elevation of the jaw joint with respect to the occlusal plane. Our data shows that relative importance of the temporalis and medial pterygoid muscles to produce bite force is affected by phylogeny but the masseter is not. Dietary differences affect the relative importance of the medial pterygoid muscle, suggesting that maybe this muscle is important for motor control to process foods of different mechanical properties. The effect of gape angle on muscle mechanics is complex, depending on the portion of the masticatory muscle (e.g., anterior vs posterior fibers).

A sub-continent of caries: Prevalence and severity in Early Holocene through recent Africans

JOEL D. IRISH[1] and FAWN CARTER[2]

[1]Research Centre in Evolutionary Anthropology and Palaeoecology, Liverpool John Moores University, Liverpool, United Kingdom, [2]Museum of the North, University of Alaska, Fairbanks AK

The most recognizable pathological condition of the human oral cavity is, arguably, dental caries. Beyond a direct impact on oral health, caries presence (or absence) provides important data for bioarchaeologists—to help reconstruct the diet of past populations and individuals relative to a variety of spatiotemporal and biocultural factors. This study explores such data in 44 samples (n=1,963 individuals, 62,816 teeth) dating between 10,000 BP and recent times across the African sub-continent. It is, to date, the most extensive investigation of its kind in this part of the world, entailing descriptions and quantitative comparisons of caries by period, environment, subsistence strategy and, of course, sex and age at various geographic levels.

Frequencies and output from Mann-Whitney U tests and factoral ANOVA provide expected and some unexpected findings, including: 1) a diachronic increase in caries prevalence across the sub-continent, likely related to diet change from widespread population movement, e.g., "'Bantu' expansion" and European immigration; 2) savanna peoples exhibit more caries than those from other environmental regions, including rainforest, desert, and coastal locations; 3) subsistence strategy plays a major role in caries occurrence as expected, e.g., agriculturalists have more and foragers fewer; 4) males and females do not evidence significant differences in caries frequencies across sub-Saharan Africa, but variation does exist in several regional groups; and 5) not surprisingly, caries frequency and severity increase relative to individual age. These findings reveal that global trends described by previous researchers often apply, though not always—so it is prudent to consider regions independently.

Data collection by the first author was facilitated through funding from the National Science Foundation (BNS-9013942, BCS-0840674), the ASU Research Development Program, and the American Museum of Natural History.

Reduced nutritional intakes in Diademed Sifakas (*Propithecus diadema*) occupying degraded habitat are reflected in morphometrics and growth – and help identify habitat thresholds

MITCHELL T. IRWIN[1,3], KAREN E. SAMONDS[2,3], JEAN-LUC RAHARISON[3], KENNETH E. GLANDER[4] and LAURIE R. GODFREY[5]

[1]Anthropology, Northern Illinois University, [2]Biological Sciences, Northern Illinois University, [3]Conservation, NGO SADABE, [4]Evolutionary Anthropology, Duke University, [5]Anthropology, University of Massachusetts Amherst

Habitat change can have varied impacts on primates, from extirpation to no change, to improved health. Even when dietary and behavioral shifts are seen, it is often unclear whether this reflects decreased health, or simply behavioral flexibility; such insight is important for conservation efforts. We present morphometric data from diademed sifakas at Tsinjoarivo, Madagascar (18 years, 171 captures, 105 individuals). Captures spanned 10 groups, including continuous forest ("CONT"), and degraded fragments ("FRAG") where sifakas have depressed nutritional intakes.

Few adult linear measurements varied across habitats: FRAG trunks were longer, and body length, leg and ulna showed a site-by-sex interaction. Strangely, all differences were driven by small CONT males. Mass showed no effect of site, but body condition, circumferences, and testicle size were lower in FRAG groups. Surprisingly, linear mixed models for immatures aged 1-4 years showed no effect of habitat, although variation at any given age was high, perhaps reflecting year-to-year environmental variation. Using "Home Range Quality Index" as a covariate rather than a CONT/FRAG dichotomy revealed a threshold; only the two FRAG groups in the lowest-quality habitat showed low adult mass and condition (wasting), and low immature mass and length (stunting).

The poor outcomes in the worst habitats follow predictions, but some fragments apparently provide viable habitat. The odd adult results defy easy explanation. We suggest they do not reflect

evolutionary change, given the recent nature of habitat fragmentation; possible causes include nutritional shortfalls, locomotor forces during growth, or non-independence of samples (if animals in nearby groups are related).

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The impact of drought on white-faced capuchins in Santa Rosa National Park, Costa Rica: A comparison of population-wide and group-based demographics

KATHARINE M. JACK[1], FERNANDO A. CAMPOS[2], JEREMY D. HOGAN[3], URS KALBITZER[4] and LINDA M. FEDIGAN[3]

[1]Anthropology, Tulane University, [2]Biology, Duke University, [3]Anthropology, University of Calgary, [4]Anthropology, McGill University

Population-wide and group-based demographic studies can inform our understanding of animal responses to changing environmental conditions, however little is known about how these two types of data compare. Since 1984, we have intensively studied 2-5 social groups and conducted 13 site-wide censuses of *Cebus capucinus imitator* in the Santa Rosa Sector of the Área de Conservación Guanacaste, Costa Rica. During this 33-year period, the population grew from 377 individuals (28 groups) to 697 individuals (45 groups), an increase attributable to forest protection and regeneration. In 2015, Santa Rosa experienced its driest year, with only 660mm of rainfall (annual mean = 1719mm). Despite a 13% increase in the population since 2015, the drought had a strong impact on population demographics. The proportion of small immatures (1-3 years) fell from 0.18 in 2015 to 0.08 in 2017 (mean over all years = 0.15), a pattern consistent with widespread infant death in our study groups during this period (infant mortality was 91% in 2015 and 40% in 2016; mean = 33%). Conversely, the proportion of infants doubled from 0.08 in 2015 to 0.16 in 2017 (mean=0.12) due to a population-wide synchrony of a new infant cohort that we also observed in our study groups. The proportion of adults (0.49 to 0.54) and large immatures (0.21 to 0.17) per group were less severely impacted, suggesting that these age classes are more resilient to short-term ecological stressors. Our findings indicate that group demographics in this population are a good proxy for studying population-wide changes.

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Reclaiming African American ancestries for research, identity construction, and memorialization

FATIMAH L.C. JACKSON

Biology, Howard University

500,000 Africans were brought to North America during the centuries of the transatlantic trade in enslaved individuals. Among survivors and their descendants, millions lived their lives, died, and were buried, often in unmarked sites. In the course of land development, road construction, and other projects that disrupt the burial sites of theses 16th-20th century individuals, African American (AA) skeletal and dental remains are uncovered. Although detailed insights of past generations of AAs are neither readily available nor adequately studied, there are no legal protections for these precious bioarcheological remains. No equivalent exists of the Native American Grave Protection and Repatriation Act to ensure and guarantee the safe-handling, respectful care, and transition of power to descendants or the AA community. As a result, systematic research on AA remains is sporadic and inadequate to fil gaps in our understanding of the historical depths of the health disparities. Our goal is to secure these AA ancestral remains for research, identification, and memorialization. These data will enrich AA biohistory scientifically, protect the legacy of past ancestry through curation of remains, and provide the necessary linkage between past medical struggles within the AA community and current health inequities. This may reveal reasonable and appropriate solutions for future improvements in health. Our goal is to increase the numbers of individual remains housed in the Cobb Research Laboratory through the repatriation of AA skeletal and dental materials currently languishing in private collections, abandoned unwanted in local universities, or relegated to the trash dumpsters at construction sites.

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Paleopathological analysis of a Frankish (7th century AD) cemetery from the Hemmaberg (Austria)

TINA JAKOB[1], MICHAELA BINDER[2], ELIZABETH A. BYRON[1] and SABRINA LH. KI[1,3]

[1]Department of Archaeology, Durham University, [2]Austrian Archaeological Institute, [3]Department of Anthropology, Durham University

The Hemmaberg in Southern Austria represents one of the most important centers of early Christianity in the Eastern Alps, with its peak dating to the 5th and 6th centuries. From the site's final period of use in the early 7th century, one of the most enigmatic periods of history in the Eastern Alps, a small cemetery with a total of 30 inhumation burials was excavated. Only six adults (4 males and 2 females), yet 24 non-adults under the age of 18 years were present, ranging from neonates to adolescents, with most of the adults reaching a mature age.

Macroscopic osteological and paleopathological analyses were used to investigate the living conditions of these people during a period assumed to be marked by economic decline as well as political and religious changes. The majority of individuals had evidence of pathological lesions, including non-specific stress indicators, such as enamel hypoplasia and cribra orbitalia. In addition, most of the non-adults also showed signs of non-specific infectious disease affecting the long bones of the arms and legs. Furthermore, many of the youngest individuals had pitting and/or new bone formation of the pars basilaris and greater wings of the sphenoid bone, which might indicate a lack of vitamin C (scurvy). Within their wider archaeological and historic context, the paleopathological data from this small group of individuals allows us to gain insight into their lives affected by significant environmental stress, complementing historic narratives of hardship and change.

Duplication and convergent evolution of the pancreatic ribonuclease gene (*RNASE1*) in a non-colobine primate, the mantled howler monkey (*Alouatta palliata*)

MAREIKE C. JANIAK[1], ANDREW S. BURRELL[2] and TODD R. DISOTELL[2]

[1]Department of Anthropology, Rutgers University, [2]Department of Anthropology, New York University

Pancreatic ribonuclease (*RNASE1*) and lysozyme C (*LYZ*) are enzymes, originally involved in immune defense, that have evolved new digestive functions in foregut-fermenting animals, like colobine monkeys and artiodactyl ruminants. In colobines, *RNASE1* was duplicated, in some species twice, with the daughter genes (*RNASE1B*, *RNASE1C*) evolving new digestive roles. Howler monkeys are the most folivorous of the New World monkeys but, lacking the sacculated stomachs of colobines, digest foliage using caeco-colic fermentation. We report on the *RNASE1* and *LYZ* genes in the mantled howler monkey (*Alouatta palliata*). Results indicate that the *RNASE1* gene was duplicated twice in *A. palliata*, leading to two daughter genes, *RNASE1B* and *RNASE1C*. While the parent gene (*RNASE1*) is conserved, *RNASE1B* and *RNASE1C* have multiple amino acid substitutions that are convergent with those found in the duplicated *RNASE1* genes of colobines. As in colobines, the duplicated RNases in *A. palliata* have lower isoelectric points, a lower charge, and changes that are indicative of a reduced efficiency against double-stranded RNA, suggesting a novel, and possibly digestive function. Howler monkey *LYZ* is conserved and does not share the substitutions found in the colobine and bovine sequences. These findings suggest that in both foregut and caeco-colic

fermenting primates pancreatic ribonuclease has convergently evolved a new role for digesting the products of microbial fermentation. Energy gains from the digestion of these products can be substantial, therefore, these duplicated proteins may be crucial digestive enzyme adaptations allowing howler monkeys to survive on a folivorous diet during times of fruit scarcity.

The Potočani Massacre

IVOR JANKOVIĆ[1,2], MARIO NOVAK[1], JAMES C.M. AHERN[1,2], JACQUELINE BALEN[3] and HRVOJE POTREBICA[4]

[1]Anthropology, Institute for Anthropological Research - Zagreb, [2]Anthropology, University of Wyoming, [3]Prehistoric Archaeology, Archaeological Museum in Zagreb, [4]Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb

During the rescue excavations in 2007, a pit containing human skeletal remains was found at Potočani in Croatia. The remains of at least 41 person of all age groups and both sexes were found, mostly articulated but commingled and without a clear pattern of organization. No associated artefacts were present in the pit except for few pottery fragments of Lasinja Copper Age Culture (c. 4300 to 3950 BCE). Three direct dates on skeletal remains from different layers of the pit all showed the same age (cca 4100 cal BCE). Radiocarbon dates, patterns and location of injuries, combined with the manner of disposal of the dead, and the characteristics of the assemblage (e.g. sex and age) all point to a single episode of violence (massacre). Here we discuss the results of bioarchaeological analysis of the sample in the context of other known mass graves from the similar timeframe. It is likely that metal axes and wedges caused cuts, puncture wounds and piercing injuries. Furthermore, trauma patterns and the location of injuries on the crania suggest execution rather than battle.

What's in a name? Revisiting the taxonomy of *Limnopithecus*, a problematic small catarrhine from the early Miocene of eastern Africa

RUTGER J. W. JANSMA and KIERAN P. MCNULTY

Anthropology, University of Minnesota

Specimens referred to the small (4-7 kg.) catarrhine *Limnopithecus* comprise a typical component of Miocene primate faunas in eastern Africa. Currently, the genus includes two species (*L. legetet* and *L. evansi*) and is documented at multiple early and middle Miocene localities in Kenya and Uganda. In contrast, other similar-sized catarrhines are recognized in more restricted stratigraphic ranges. A major obstacle with referring specimens to *Limnopithecus* is the poor quality of the holotype of *L. legetet* (BMNH M. 14079), a mandibular corpus fragment from the Maize Crib Locality (Koru, Kenya) preserving the lower M1 and M2. Here we report results of a comprehensive redescription of *Limnopithecus* and its affiliated species based on firsthand examination of all relevant material. Our study finds that none of the assigned material closely approximates M. 14079, which differs from all other catarrhines except the much larger *Proconsul meswae* in combining isodont lower molars with a breadth-length index exceeding 85%, distolingually oriented postmetacristids, and a hypoconid that exceeds all other cusps in size. The holotype of *Xenopithecus*, a somewhat larger form known only from the same locality as *Limnopithecus*, shows an upper M2 that also resembles *P. meswae*. A statistical comparison with 45 anthropoid taxa reveals that the size difference between holotypes of *Limnopithecus* and *Xenopithecus* is extreme but within the range of variation in some extant taxa, which is suggestive (but not demonstrative) of their synonymy.

This research was funded by the Leakey Foundation and the University of Minnesota.

Cortical bone nano-structure in the human first metatarsal

TEA JASHASHVILI

Molecular Imaging Center, Department of Radiology, Keck School of Medicine, University of Southern California, Evolutionary Studies Institute, University of the Witwatersrand, Department of Geology and Paleontology, Georgian National Museum

The biomechanical properties of bone are extensively studied using Macro (cross-sectional properties by simple beam theory) and Micro structure of bones (trabecular structure predicting elastic moduli using the fabric tension and density). Since the bone cellular network can monitor habitual stress modes (e.g., tension, compression) by creating regional modification, Nano-level three-dimensional analysis was used to study the bone adaptation by exploring osteocyte lacuna population and neurovascular canal densities in the cortical bone.

In this study, I am investigating difference between plantar and dorsal cortices in a human 1st metatarsal, which theoretically experiences the compression stress on the dorsal cortex and tensile stress on the plantar cortex, originating from ground reaction forces during dorsiflexion. I am testing hypothesis that compressive stress could produce a high rate of harversian canal remodeling and formation of secondary osteons relative to the tensile stress. Lacunar density differences also could be linked to compression and tensile stress areas of the bones.

To avoid bias in the remodeling process introduced by age, I have used a single individual to compare dorsal versus plantar midshaft regions of interest (ROI). The ROIs were scanned using Nano-computed tomography (Rigaku/nano3DX) at 0.3micron voxel size. The preliminary result shows substantial differences in the harversian canal network as well as in the lacunae density between plantar and dorsal cortices where the latter has higher values. Thus, the result follows a predicted model and will benefit from a larger samples size that will be tested in a subsequent study.

Long-term costs of reproduction: high number of children, especially sons, leads to poor maternal health

GRAZYNA JASIENSKA

Department of Environmental Health, Jagiellonian University

Reproduction requires substantial energy and causes changes to maternal physiology. Life history theory predicts that resources invested in reproduction trade-off against investment in maintenance. We ask if reproduction in humans has long-term negative consequences for maternal organism, i.e. if is related to poor health in post-reproductive period.

Health consequences of reproduction were studied among 415 post-reproductive women from rural Polish population with parity of 1 to 13 children (mean 4.1), using a composite index of health of up to 17 measured variables characterizing cardiovascular health, lipid profile, inflammation, physical strength, cognitive decline, and risks of obesity, anemia and diabetes. Each variable, coded 1 (values within clinically established norms) or 0 (outside of norms) contributed equally to the total score. Our index was found to be consistent with the 5-level self-reported health scores (mortality predictor used in epidemiology) and shows the expected pattern of significant age-related decline.

Women's reproductive investment, expressed as the number of children, was associated with a decline in the index of health ($p=0.0006$, with negative age effects accounted for). The number of sons born to a mother had a significant detrimental effect on her health status ($p=0.0054$), about 1.4 times more so than the number of daughters ($p=0.034$). This is the first study that tested trade-offs between reproduction and health in agricultural population using comprehensive, integrated assessment of health rather than single health indicators, or incidence of selected diseases. Costs of reproduction in women with high parity may last well beyond reproductive years.

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Variation in physical activity between families in rural Dominica

THOMAS C. JASKOWIEC

Department of Anthropology, University of Missouri

Physical activity and its impact on both adolescent and adult health status has become an ever increasingly relevant topic in health studies. As societies transition from agrarian economies to industrial economies, the epidemiological shift to a larger proportion of chronic diseases fundamentally changes how healthcare and public health campaigns are designed and implemented. Diabetes and obesity are a direct result of shifting food strategies (small-scale subsistence farming to store purchased, processed foods), and are continually growing in westernizing societies. The accurate assessment of physical activity can inform anthropological researchers and health officials on the best applications of limited resources to combat these expanding rates in communities. This study employed 25 wrist-based fitness monitors, each given to a participant for a minimum of 14 days (n=72). The sample ranged from 4-73 years old, with a mean family size of 3.72 members. Physical activity was assessed using steps taken, distance traveled, calories burned, and elevation changes recorded on the fitness monitors. The monitors were calibrated for individual participants' height, weight, and age. Each measurement was analyzed independently, with combined measures being adjusted for age and sex differences between families. There were significant differences ($p < .05$) in steps taken, distance traveled, and elevation changes between families, while location in community also had a significant impact on elevation change ($p < .05$). Having an accurate, objective measure of physical activity can improve health research projects and implementing health interventions in communities.

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The effects of cancer treatment-induced bone loss on morphological sex assessment

KALAN L. JASNY[1] and SEAN D. TALLMAN[1,2]

[1]Anatomy and Neurobiology, Boston University, [2]Anthropology, Boston University

Cancer is currently the second most common cause of death in the U.S. As treatments for cancer are rapidly changing, it is vital to understand how these medications affect the human skeleton. Presently, little research has been conducted on how medications alter the skeleton and impact the biological profile. One of the primary side effects of drug-based treatments is cancer treatment-induced bone loss (CTIBL), which may impact the expression of sexual dimorphism. It is hypothesized that CTIBL will decrease the robusticity of sexually dimorphic nonmetric traits, and skew the ordinal scores towards gracile. A total of 178 individuals with documented cancer and/or treatment and 178 individuals without documented cancer from the William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville, were assessed following conventional standards for the skull and os coxa. The individuals ranged in age from 26 to 97 years and included 350 European Americans, two African Americans, one Asian/Polynesian, and three Native Americans. IBM's Statistical Package for Social Sciences (SPSS) calculated Chi-Square and ANOVA analyses. The results indicate no relationship between cancer treatment status and the trait scores ($p > 0.05$). Possible confounders of the study include the unknown duration of cancer treatments and the assumption that the individuals included in the sample were accurately documented. Though CTIBL does not appear to affect morphological sex assessment, further research should be conducted on the possible effects of CTIBL for other components of the biological profile.

First evidence of subadult periosteal lesions in Pre-Columbian Manabí, Ecuador

NICOLE A. JASTREMSKI, PHD[1] and VALENTINA L. MARTINEZ, MA[2]

[1]Anthropology and Musuem Studies, Central Washington University, [2]Anthropology, Florida Atlantic University

Poor preservation makes identification of pathological lesions in subadult human remains difficult. In coastal Ecuador, the small bones of subadults, taphonomic processes, and mortuary processes, all provide biases against not just identifying pathology on subadult bones, but often the discovery of subadult bones at all. Previously, the only other reported subadult remains with periosteal lesions in Ecuador consisted of one long bone fragment within the Ayalán burial cemetery as identified by Ubelaker in 1981. This new find is from site N4C3-35, located near the town of Salango, encompassing several urn burials belonging to the Manteño culture. In Area 2 (35-2), a secondary urn burial consisting of commingled adults and subadults with diverse health statuses was analyzed. Preliminary results indicate that within this burial, at least two subadults exhibit active and healed periosteal lesions. These infections coupled with other subadult pathological conditions, within this burial, such as cribra orbitalia, porotic hyperostosis, and a possibility of scurvy, leads to the conclusion that infectious disease was a major contributor to the stress of the population during the Integration Period (A.D. 700 – A.D. 1532).

Site Formation at the Australopith locality, Kantis Fossil Site, Kenya

KIRSTEN E. JENKINS[1] and EMMA MBUA[2]

[1]Department of Anthropology, University of Minnesota, [2]Department of Earth Sciences, National Museums of Kenya

Kantis Fossil Site is a dense bone bed that has yielded both the earliest *Australopithecus* remains in Kenya (3.3 - 3.6 mya) and the only known *Australopithecus* remains outside of the Kenyan Rift Valley System, approximately 25 km southwest of Nairobi in the Ngong Hills. To date, 163 m^2 have been excavated, and preliminary taphonomic findings suggest a complex depositional history. A survey of excavated materials has yielded several high-angled bone shaft fragments, probable algae damage, variable bone rounding, and probable trampling marks. Relevant observations were also made during excavation; bone fragments are oriented in multiple planes with random angles and some large mammals are partially articulated. Geologic evidence notes the presence of lahar, flood, and fluvial deposits, as well as footprints identified in cross section. These data, taken together, suggest that multiple bone accumulating agents contributed to the bonebed at Kantis; likely including carnivores, reworked fluvial and lahar accumulations, and natural trap miring. These findings indicate early *Australopithecus* inhabited a dynamic landscape and should be taken into account when comparing faunal assemblages across localities.

Funding for taphonomic research at KFS was provided by the Leakey Foundation.

Imputor: Phylogenetically aware software for imputation and correction of errors in next-generation sequencing

MATTHEW J. JOBIN[1,2], HAIKO SCHURZ[3] and BRENNA M. HENN[4]

[1]Anthropology, University of California, Santa Cruz, [2]Anthropology, Santa Clara University, [3]Molecular Biology and Human Genetics, Stellenbosch University, [4]Ecology and Evolution, Stony Brook University

Advances in next-generation sequencing (NGS) have provided researchers with an unprecedented wealth of data, but short-read data has proven variable in its fidelity to the original sequence. Briefly, short "shotgun" sequencing reads are mapped to the reference genome and a series of algorithms are used to identify sample alleles that differ from the reference genome. Spurious sequencing errors are abundant which leads to set of stringent filters during the variant calling process; these filters can accidentally remove true variants which are then replaced by the reference genome allelic state. Additionally, low coverage data results in many missing sites across the sample sequence. Missing data is typically "imputed" using a population reference panel of thousands of individuals. However, this

process relies on the presence of similar haplotypes having been sequenced by consortia such as the 1000 Genomes Project and may perform poorly in many diverse human populations.

We thus introduce IMPUTOR, phylogenetically-aware software for imputing missing and correcting sequencing errors via the principle of parsimony in haploid, non-recombining data. Neighboring sites on a phylogenetic tree that are identical by descent for a derived allele are unlikely to experience a reversion to an ancestral allele amongst their members. By the use of this principle and trees constructed by methods including maximum likelihood and maximum parsimony, IMPUTOR can impute and correct a large majority of miscalled sites given optimal parameter values. IMPUTOR can make imputations and corrections to any haploid dataset without adding samples or comparing to a larger reference dataset.

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Adult female baboons demonstrate craniofacial age-related changes that have the potential to bias inferences made from assessments of their intrapopulation variation

JESSICA L. JOGANIC and YANN HEUZÉ

UMR5199 PACEA, University of Bordeaux

The effect of ontogenetic variation within populations has been well studied and is often accounted for in paleoanthropological research. However, the degree to which the skull remodels once an individual reaches adulthood is less well studied. Furthermore, the affect such age-related changes may have on distributions of sample variation and the statistical inferences we subsequently draw from them is almost entirely unknown. Here, we test the assumption that age-related changes in the adult craniofacial skeleton do not bias our interpretations of skeletal samples. We quantify variation in a sample of 100 known-age female baboons (7.1–32.5 years) by capturing a set of 43 craniometric landmarks, 48 curve semi-landmarks, and 210 surface semi-landmarks from skull CT scans. A Procrustes superimposition was performed on the landmark configurations and the resulting Procrustes coordinates were analyzed to examine the relationship between chronological age and shape while accounting for antemortem tooth loss. Results indicate that 6% of total shape variance can be explained by size and an additional 4% by age (both $P<0.001$). Of the age-related shape variation, a significant 22% is explained by principal component 2. Along this axis, young adults are characterized by arched cranial bases and more globular anterior and posterior cranial fossae while elderly individuals have compressed orbits, deep maxillary fossae, and crania that are flattened in the transverse plane. Additionally, the randomization procedure we performed to assess the sampling bias effect suggests that age should be considered an important confounding factor regardless of whether an individual is "mature."

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Forest baboons maximize energy and prioritize protein: implications for evolution of human diet

CALEY A. JOHNSON[1,2,3,4], DAVID RAUBENHEIMER[5], LARISSA SWEDELL[1,2,6,7] and JESSICA M. ROTHMAN[1,2,8]

[1]Anthropology, Graduate Center of CUNY, [2]New York Consortium in Evolutionary Primatology (NYCEP), American Museum of Natural History, [3]Center for Evolution and Medicine, Arizona State University, [4]School of Human Evolution and Social Change, Arizona State University, [5]School of Life and Environmental Sciences, University of Sydney, [6]Anthropology, Queens College of CUNY, [7]Biology, Queens College of CUNY, [8]Anthropology, Hunter College of CUNY

The amounts and balance of nutrients consumed, as well as rules of nutrient compromise, are important factors determining health, longevity, and reproductive success. Baboons (*Papio*) provide an excellent opportunity to study these factors within the context of a generalist-omnivorous foraging strategy. While the ecology of savanna-living baboons is generally well studied, the ecology of forest-living baboons is not. Here we report results from a study of olive baboons (*P. hamadryas anubis*) in a closed but heterogeneous forested habitat. We performed all day focal follows on individual females, and quantified nutrient intake from feeding observations and nutritional analysis of the foods consumed. We used the geometric framework of nutrition to examine how individuals prioritize nutrients when forced to compromise based on changing seasonal food availability. Similar to humans, female baboons maintained an intermediate macronutrient balance of 5.0:1 kilocalories of non-protein energy (NPE) to protein (P) based on annual intake. As food availability changed seasonally, baboons exploited energy where possible and maintained protein intake. We found that lactation and pregnancy increased the energetic demands of females and increased the proportional balance of energy to protein by +1.3:1 kcal NPE/P. This pattern of protein prioritization is also displayed by humans, and is considered central to the underpinnings of obesity and associated cardiometabolic disease, whereby humans over consume energy to maintain protein intake. These results suggest that that protein prioritization in both baboons and humans is likely the result of an evolved ecological strategy that allows them to exploit energy in multiple environmental contexts.

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The effect of muscle mass and exercise on proximal femoral shaft strength in NHANES III runners

ROBYN A. JOHNSTON and LIBBY W. COWGILL

Anthropology, University of Missouri

The effect of mechanical loading on femoral geometry has been a long-standing area of research. One debate has been whether increased muscle strength or increased total load is the primary contributor to the bending strength of long bones. Samples examining the relationship between loading and femoral geometry have often compared overweight and obese samples, who are usually sedentary, or professional athletes who are incredibly lean, which fails to separate out the confounding effects of total load through mass versus muscle mass. This project uses the Third National Health and Nutrition Examination Survey (NHANES III) dataset to examine how active individuals with different body compositions vary in proximal femoral geometry. The sample includes 452 individuals (348 males/104 females), all who reported running/jogging minimum 10 times in the past 30 days. Skinfold measurements were used to separate individuals into high, medium, or low amounts of lean muscle mass. Cross-sectional area was estimated using dual energy x-ray absorptiometry (DEXA) scans of the femoral shaft, directly below the lesser trochanter, and the Hip Structure Analysis program. Femoral total cross-sectional area was standardized by total body mass, and ANOVA was used to identify statistically significant differences in bone strength among the high, average, and low muscle mass groups, with bone total area positively correlated with muscle mass ($p<0.001$). This analysis suggests that muscle forces, and indirectly exercise, play an important role in femoral strength even beyond the effect of total mass loading.

Response to Economic Crisis Reveals Risk-Averse Fertility Preferences

JAMES HOLLAND JONES

Earth System Science, Stanford University, Life Sciences, Imperial College London

Evolutionary analyses of human reproductive decision-making typically measure fitness using lifetime reproductive success. This fitness measure implicitly assumes that women are risk neutral in their decisions since all births contribute equally to fitness. However, ample demographic evidence demonstrates that the decision to have another child is fraught with risk and that such

risks are magnified during periods of economic crisis. I employ an alternative measure of fitness, the individual rate of increase, which predicts that mothers should be risk averse in their reproductive decisions. Using the theory of decision-making under risk, I predict that risk-averse women should reduce fertility during economic shocks, but that this reduction should be modified by age. Specifically, older women should be less risk averse than younger women because diminishing marginal fitness gains mean that older women pay less cost in the case of an adverse outcome. Using a genealogically detailed demographic database from historical Utah and a series of generalized additive models, which account for the substantial nonlinear responses of fertility, I test this prediction. During the banking crisis of the Great Depression, young women dramatically reduced fertility. However, age modified this effect such that while younger women substantially reduced fertility, older women actually increased their fertility in the face of the uncertainty of the economic crisis, confirming the hypothesis that these women employed risk-averse decision making in their reproductive tactics. This finding has powerful implications for understanding fertility transitions.

Mummies, Skeletons, and Museums: Representing human remains to the public

KELSEY C. JORGENSEN

Anthropology, Wayne State University

For many people, their first encounter with biological anthropology is viewing human remains in a museum. The opportunity to educate the public with these sensitive 'materials' requires museums to make nuanced decisions regarding whether to display human remains, and if so, how to portray them. The aim of this study was to review which major museums chose to display human remains and whether certain types, such as skeletons or mummies, were humanized or objectified. Interviews with curators and personnel from 28 museums across the United Kingdom and United States were conducted to determine existing museum policy for displays featuring human remains. While half of these museums had policies regarding exhibiting human remains, only one specifically dictated whether human remains were 'once living persons' or 'objects.' Consequently, both U.S. and U.K. museums had conflicting degrees of humanization in the portrayal of human remains. Incomplete human remains, such as a specific skeletal or tissue region, were most significantly correlated to objectification. In contrast, the more complete the human remains, the more consistently they were given agency. No significant pattern was detected in relation to type of human remains, the remains' geographic provenience, or time period. Bias towards either humanizing or objectifying human remains often stemmed from the opinion of the museum employee with the sovereignty to create the display. As museums have inherent sanctity in educating the public, examining the objectification or humanistic portrayals of human remains provides insight into the continual progress within the field of biological anthropology.

Reconstructing Diet for a population of Colonial Enslaved Africans

CHELSEY A. JUAREZ[1] and BROOKE E. CROWLEY[2]

[1]Anthropology, NC State, [2]Geology and Anthropology, University of Cincinnati

We analyzed carbon and nitrogen isotopes in bone collagen and carbon isotopes in bone apatite to investigate diet for 35 enslaved Africans from 1700's Charleston. The population includes three groups (identified using oxygen, and strontium isotopes): Charleston natives (N=23), African born long-term Charleston residents (N=7), and African born short-term Charleston residents (N=5).There were no significant differences in $\delta^{13}C_{apatite}$, $\delta^{13}C_{collagen}$, $\delta^{15}N_{collagen}$, or the offset between collagen and apatite ($\Delta^{13}C_{collagen\text{-}apatite}$) among groups. Nevertheless, interesting patterns were noted. Combining Charleston natives and Long-term residents due to their shared history, females had slightly higher $\delta^{15}N$ collagen and and slightly lower $\delta^{13}C$ collagen than males. These differences may be related to 1) differing levels of nutritional stress, 2) lactation in adult females, or 3) variable meat consumption. Further separating females into "adult" and "older adult," all females had higher $\delta^{15}N$ collagen than males, but only adult females had lower $\delta^{13}C$ collagen than males, which supports the lactation option. Historical records indicate that pork, beef, and corn were common diet provisions, and that enslaved Africans kept large gardens of C_3 vegetables. Overall, our results support regular consumption of pork and C_3 vegetables, moderate reliance on corn, and limited bushmeat for Charleston natives and long-term residents. However, there was considerable variability among individuals. Several individuals relied more heavily on marine foods, two individuals likely consumed C_4 protein and energy, and one had a strictly C_3-based diet. Most short-term residents had diets comparable to Charleston natives but one relied more on C_3 protein and C_4 energy.

Ontogenetic changes in morphological integration in the macaque cranium and mandible

HYUNWOO JUNG and NOREEN VON CRAMON-TAUBADEL

Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo

The aim of this study was to examine ontogenetic changes in patterns of primate cranial integration. Due to their early development, it is hypothesized that the vault, chondrocranium, and mandibular corpus will show more consistent levels of integration across age groups than the face and mandibular ramus, which are more prone to function-induced plastic changes.

3D surface scans of 60 juvenile and 20 adult macaques were analyzed. Juveniles were split into two groups based on the eruption status of the permanent canine. Configurations of 3D landmarks were captured from the cranium and mandible and converted into Procrustes coordinates. Integration was quantified using the ICV (CV of eigenvalues) for each module based on a resampling procedure, and statistically compared using two-way ANOVA.

For the vault and chondrocranium, adult ICV scores were significantly higher than juveniles, with no significant differences between juvenile groups. For the ramus, only juveniles without permanent canines showed significantly lower ICV scores than other groups. In contrast, for the face and corpus, ICV scores fluctuated and were statistically different among age groups. Among modules, the vault and chondrocranium showed significant differences in integration in adults but not in juveniles. The face was significantly less integrated than the vault or chondrocranium in adults, but significantly more so in juveniles. The corpus was significantly less integrated than the ramus in juveniles with permanent canines but significantly more so in adults and juveniles without permanent canines. These results indicate support for the hypothesis for cranial modules but not for the mandible.

Bystanders' presence and rank affect grooming decision making in two wild chimpanzee communities

STEFANO SK. KABURU[1] and NICHOLAS E. NEWTON-FISHER[2]

[1]Department of Population Health and Reproduction, University of California, Davis, CA, U.S.A., [2]Living Primates Research Group, School of Anthropology and Conservation, University of Kent, Canterbury, U.K.

One of the central concerns of socio-biology is to understand the evolutionary strategies individuals use to maximize benefits and reduce costs in cooperative interactions. Studies of non-human-primate cooperation have focused particularly on social grooming, given the costs it imposes on the groomer and the benefits it provides to the recipient, concentrating primarily on the characteristics of the grooming dyad. In this study, by contrast, we explored the influence of bystanders' presence and rank, since such bystanders create a temptation to defect from the current partner. Our study was conducted on two wild chimpanzee communities, in Budongo (Uganda) and Mahale (Tanzania), which showed substantial difference in dominance structure: despotic (Budongo) and egalitarian (Mahale). The

results showed that among Budongo chimpanzees, groomers invested less when there was a high-ranking bystander (Estimate: 16.8, p = 0.01) and when the difference between this bystander's rank and the current partner's rank was greater (Estimate: -11.2, p = 0.007). By contrast, grooming investment among Mahale chimpanzees was affected by the number, but not the rank(s), of bystanders: in the presence of more bystanders groomers invested less (Estimate = -10.93, p = 0.03) and grooming bouts were less reciprocated within the dyad (Estimate = -0.158, p = 0.028). Overall, our work is the first to provide evidence that bystanders' presence and rank can influence grooming interactions in non-human primates, providing important insight on the strategies and factors that can explain the evolution of cooperation in social animals, including humans.

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Chewing biomechanics reveals different strategies among great apes

THOMAS M. KAISER, JORDI MARCÉ-NOGUÉ, JUAN-PABLO GAILER and FREDERIK JESSEN

Mammalogy, Paleoanthropology, Center of Natural History, University Hamburg

The relationship between diet and dental morphology in primates has been intensively studied in recent years, applying a wide array of techniques including morphometry and biomechanical analyses based on high resolution 3D occlusal models. Here we investigate the cheek tooth occlusal morphology and biomechanics performing Topographic Analysis (MTA) and revealing the effect of comminution. We employ non-linear Finite Element Analysis (FEA) on a virtual bolus of food loaded between a series of positions of extant great ape (*Pan troglodytes*, *Gorilla gorilla, Pongo pygmaeus* and *Homo sapiens*) post-canine tooth rows.

We selected individuals strictly representing the same stage of tooth wear and observe species specific patterns of biomechanical parameters relevant to crack formation in MTA and FEA. We consider these patterns to reflect evolutionary strategies of functional adaptation that are widely independent of each other.

FEA suggests chimpanzees and humans to cause most damage to a bolus in terms of stress and crack induction as compared to orang and gorilla. The letter two species show higher similarity that is likely reflecting a specific energetic strategy of comminution.

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New approaches to juvenile age estimation in forensics: Application of transition analysis via the Shackelford et al. method to a diverse modern subadult sample

KELLY R. KAMNIKAR[1], NICHOLAS P. HERRMANN[2] and AMBER M. PLEMONS[1]

[1]Department of Anthropology, Michigan State University, [2]Department of Anthropology, Texas State University

Dental development is one of the most widely utilized and accurate methods available for estimating age in subadult skeletal remains. The timing of tooth growth and development is regulated by genetics and less affected by external factors, allowing reliable estimates of chronological age. Traditional methodology focused on comparing tooth developmental scores to corresponding age charts.

Using the Moorrees, Fanning, and Hunt developmental scores, Shackelford and colleagues embed the dental development method in a statistical framework based on transition analysis. They generated numerical parameters underlining each 'stage' and age-at-death distribution, and applied them to early modern humans and Neanderthals. We use the same methods on two subadult samples (n=1699), representing modern individuals that may become part of the forensic record. We assess the probability coverage of the Shackelford et al. method derived from MFH standards as it applies to all available dentition.

Results indicate promise as the age range at 90%, 95% and 99% confidence levels include the chronological age of almost every individual tested. The maximum likelihood point estimates were separated by quartiles, and the median MLE ages were compared to chronological age. From ages 2 to 12, the MLE and chronological ages were not significantly different, but differences increased at age 13, as previously shown. We adjusted the numerical parameters underlying the stages for developing teeth based on the combined sample, and results from testing with a modern forensic sample will be presented. This study shows that the Shackelford et al. method is applicable and accurate when aging subadults.

Ingestive Behavior of Bornean Orangutans (*Pongo pygmaeus wurmbii*): coping with mechanical challenges while foraging

ERIN E. KANE[1], W. SCOTT MCGRAW[2], TIM LAMAN[3], TRI WAHYU SUSANTO[4] and CHERYL KNOTT[1,4]

[1]Anthropology, Boston University, [2]Department of Anthropology, The Ohio State University, [3]Museum of Comparative Zoology, Harvard University, [4]., Gunung Palung Orangutan Conservation Project

Bornean orangutans (*Pongo pygmaeus wurmbii*) preferentially eat pulp and mesocarp when fleshy fruit is abundant. However, during non-masting periods, orangutans rely on foods that can be mechanically challenging, including leaves, woody plant tissue, and seeds. Although adult orangutans' jaws are well adapted for intense and, perhaps, repetitive loading during chewing, it may be easier for flanged adult males to process tough or hard foods than for adult females because of dramatic sexual dimorphism. Here, we use video data and *in situ* focalobservations from Gunung Palung National Park, West Kalimantan, Indonesia to test the hypotheses that orangutans exhibit food- and sex-specific oral processing profiles.

Pilot data (n=94 feeding bouts; 76 adult females, 18 adult males) suggest no significant differences in use of incisors (F(3,71)=0.41, p=0.75), canines (F(3,71)=0.78, p=0.52), or molars (F(3,71)=0.88, p=0.46) per ingestive action while processing fruit, leaves, termites, or bark. Females used significantly more incisions per ingestive action (2.20) than males (1.01) (t=2.44, p=0.008), and, though differences were not significant, performed more canine bites (female mean=0.08, male mean=0.00, p=0.17) and mastications (female mean=4.88, male mean=3.95, p=0.24) per ingestive action than males.

We detected no difference in the behaviors used by orangutans to process different food types, despite great variation in food mechanical properties. However, this may be because our pilot data did not capture the range of mechanical challenges in orangutan diets. Nevertheless, our preliminary results support the hypothesis that adult females work harder than flanged males during oral food processing, explicable due to sexual dimorphism.

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Late copper age population dynamics in the Carpathian Basin

AMY N. KARABOWICZ

Department of Anthropology, University of Pittsburgh

The skeletal remains of neonates and subadults provide information about cultural practices and demography of past populations. The present study presents a preliminary analysis of population dynamics via subadult data from Budakalász, a Late Copper Age (3500-2700 B.C.) cemetery in Europe's Carpathian Basin located north of Budapest, Hungary. The Budakalász cemetery is associated with the Baden culture and more than 450 individuals were excavated from the site. While approximately 16% of the burials are cremations, inhumations predominate. 180 subadults (individuals less than 20 years old) were selected for analysis, with 23 individuals

aged 0-1 years and 157 individuals aged less than 20 years. Drawing primarily on the subadult data, population mortality and fertility are evaluated including the calculation of the Gross Reproductive Rate (GRR) from the subadult fertility formula. Burial practices are assessed in conjunction with the subadult demographic data, and cultural implications are discussed. Potential sources of bias in the Budakalász skeletal series and their effects on demographic reconstruction are also explored. This project aligns itself with ongoing efforts to reconstruct Copper Age population dynamics for the region.

Consistency and diversity of male life history and social structure: Insights from long-term study of Japanese macaques (*Macaca fuscata*)

TATSURO KAWAZOE

School of Sociology and Anthropology, Sun Yat-sen University

Life history is one of the essential aspects to seek biological evolution. However, especially male life histories in non-human primates and its relevance to humans are still unclear due to lack of data based on long-term observation. Macaques form multi-male and multi-female groups. Male macaques disperse from their natal group and repeatedly migrate between groups, and some males form all-male groups or spend solitary life stage. Japanese macaques are one of the non-human primates which have been studied for long period. I reviewed age at dispersal, tenure, immigration pattern, and the demography to show consistency and diversity of life histories on male Japanese macaques. I also analyzed affiliative relationships among males and its relevance with age to discuss the possibility that male social bonds will affect their immigration. I reviewed data collected in Kinkazan and Yakushima where is the long-term study sites of wild non-provisioned Japanese macaques. I also collected behavioral data on male affiliative interaction from 2007 to 2010 in Kinkazan. Male macaques tended to show the consistency about their age of natal dispersal, social mechanisms of dominance rank change, and residence time in one bi-sexual group. However, the ratio of males to females in one group and the dominance rank at bi-sexual group entry was differed between two sites. The younger males tended to engage affiliative interaction with other males more frequently. These findings of consistency, differentiation, and age dependence on male life histories in a non-human primate would contribute to well understanding of life-history in humans.

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The association between knee breadth and body mass

ASLA KEISU[1], PETTERI OURA[2,3,4], JAAKKO NIINIMÄKI[2,3], MARKKU NISKANEN[5], JUHA AUVINEN[2,4], TIMO ARVOLA[2,3], CHRISTOPHER B. RUFF[6], JUHA TUUKKANEN[1,2], PETRI LEHENKARI[1,2,7] and JUHO-ANTTI JUNNO[1,2,4,5]

[1]Cancer Research and Translational Medicine Research Unit, Faculty of Medicine, University of Oulu, [2]Medical Research Center Oulu, Oulu University Hospital and University of Oulu, [3]Research Unit of Medical Imaging, Physics and Technology; Faculty of Medicine, University of Oulu, [4]Center for Life Course Health Research, Faculty of Medicine, University of Oulu, [5]Department of Archeology, University of Oulu, [6]Center for Functional Anatomy and Evolution, Johns Hopkins University, [7]Department of Surgery and Intensive Care, Oulu University Hospital and University of Oulu

Body mass estimation from skeletal dimensions is a useful tool for studies of archeological human populations and early hominins. Bony articular surface areas have been used to estimate body size, especially body mass. In this study breadth of distal femur and its association with body mass in modern humans was investigated. Body mass estimation equations were derived from distal femur measurement in a modern sample of Northern Europeans with known body mass.

Our study sample consists of 1484 subjects belonging to the Northern Finland Birth Cohort 1966. Breadth of distal femur (femoral biepicondylar breadth) was measured of subject's lower limb posterioanterior-radiograph taken at 46 years old. Measurements were analyzed using a linear regression against the subjects' weight at 31 years old.

Statistically significant associations were detected between distal femur breadth and weight at 31 years in both genders ($P < 0.001$). R-values of the linear regression models were 0.412 among men and 0.457 among women. We developed linear regression equations for body mass (BM) estimation purposes for both genders. Equation for men: $BM = 1.21 \times FBEB - 26.62$ and for women: $BM = 1.44 \times FBEB - 47.43$.

Our results demonstrated that distal femur breadth is associated with body mass. Findings of this study are in accordance with earlier studies and thus we conclude that breadth of distal femur is a determinant of early adult body weight and can be used to estimate body mass.

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Neurological deficiencies due to antemortem cranial trauma in the Chanka polity of Andean Peru (1000-1400 CE)

SKYLER J. KEITER[1] and DANIELLE S. KURIN[2]

[1]Anthropology, University of Massachusetts Amherst, [2]Anthropology, University of California Santa Barbara

This study examines the antemortem cranial trauma found on skeletal samples from seven Late Intermediate Period sites in the province of Andahuaylas, Peru. Each site was identified as being inhabited by Chanka populations based on burial patterns and the presence of Chanka-style ceramics. 124 crania were assessed for age, sex, and presence of trauma. Crania were also measured to determine the degree of cranial modification present and its effect on the size and location of lobes of the brain. Crania showing trauma were further assessed for type of trauma, lethality, location, and evidence of healing. Location of trauma was correspondingly mapped onto images of the brain to determine possible impacts on neurological function present in the population. Results showed that half of the entire sample displayed evidence of cranial trauma and there was no significant statistical difference in trauma rates between males and females. Blunt-force trauma to the frontal and parietal bones were the most common forms of injury, corresponding to deficiencies in concentration, judgement making, voluntary muscle movement, eye movement, and language comprehension.

Ritual diet compared with quotidian diet: A comparison of macrobotanical remains and human stable isotope values from the site of Tenahaha (A.D. 850-1050) during the Andean Middle Horizon

CORINA M. KELLNER[1], AARON MAYER[2], MATTHEW SAYRE[3] and JUSTIN JENNINGS[4]

[1]Anthropology, Northern Arizona University, [2]Anthropology, University of South Dakota, [3]Anthropology, University of South Dakota, [4]Old World Archaeology, Royal Ontario Museum

As people do today, prehistoric populations actively chose which foods were used in different contexts. Ritual or communal meals may include special foods or different preparation in contrast with quotidian meals. We compare plant remains with human bone collagen isotope values to understand food practices at the ancient Andean site of Tenahaha in the Cotahuasi Valley (AD 850-1050). Tenahaha was built during the Middle Horizon to take advantage of new social interaction spheres, stimulated in part by the rise of the Wari state. Tenahaha includes extensive burial areas, open communal spaces, and food storage and preparation zones, but was not a residential site. Macrobotanical remains were found in public rather than private locations at the site, indicating communal production of food and drink. C3 foods such as quinoa, tubers, and

molle were ubiquitous at the site. Chicha beer made of maize and molle was likely produced and consumed at the site. The majority of the botanical remains suggest a ritual or communal diet that was heavy in C3 foods. In comparison, stable isotope analysis of individuals buried at the site shows an average daily diet dominated by C4 plants (maize) and meat (e.g., maize foddered camelids), similar to elite inhabitants of the Wari secondary city of Conchopata. People buried at the site may have been the Cotahuasi elite. Taphonomic concerns should not be ruled out, but the communal use of C3 foods (quinoa, potatoes) suggests active differentiation between daily diet and ritual diet at Tenahaha.

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Mandibular morphology as a contributor to dental macrowear patterning

CHRISTA D. KELLY and CHRISTOPHER W. SCHMIDT

Anthropology, University of Indianapolis

It has long been recognized that diet affects both mandibular morphology and dental wear. However, the relationship between mandibular morphology and dental wear is poorly understood, partially as a result of the complexities associated with clarifying the intersections of age, biomechanics, and diet.This study examines the relationships between dental wear and mandibular morphology within developmental age groups in order to understand how the growth of the mandible relates to dental wear. Forty-six individuals from the Hamann-Todd Osteological Collection, age 1 to 21 years, were included in the study, allowing researchers to control for age, sex, ancestry, and diet. Standard mandibular measurements were taken, and macrowear scores for dlp3, dlp4, and LM1 were recorded for each occlusal quadrant. Correlations were found between mandibular measurements and macrowear scores for each age group. Within the younger age groups, mandibular length was found to correlate strongly with wear. As age increased, breadth measurements showed stronger correlations with dental wear. The results indicate that mandibular morphology varies with dental wear in a manner independent of age. As mandibular growth progresses, the impact of the varying morphological characteristics on teeth changes, suggesting mandibular biomechanics change with age. Although preliminary, these results provide evidence that dental wear varies with mandibular morphology, and further our understanding of the foundation of dental wear formation.

Effects of reduced binocular visual field on leaping performance in a small-bodied strepsirrhine (*Cheirogaleus medius*)

ADDISON D. KEMP

Anthropology, University of Texas, Austin

The Grasp-Leaping Hypothesis proposes that diagnostic crown primate traits, including a large field of binocular vision, evolved to facilitate a locomotor pattern characterized by powerful jumps between supports that are grasped precisely upon landing. This hypothesis suggests that a wide binocular field evolved to provide the improved depth perception necessary for early primates to accurately judge the distance to the next substrate. The ability of the Grasp-Leaping Hypothesis to explain the evolution of a wide binocular field was evaluated experimentally by testing the underlying assumption that a wider binocular field improves leaping performance.

The correlation between leaping performance and binocular field size was tested in *Cheirogaleus medius*, a small-bodied (~175 g) nocturnal strepsirrhine. Five individuals were filmed leaping between thin (0.75cm) vertical supports under normal (n=80 leaps) and reduced binocular field (n=80 leaps) conditions. Binocular field restriction was achieved using a head-mounted blinder that blocks the medial visual field of one eye. Generalized linear mixed effects models were used to evaluate the effect of visual condition and individual on five performance variables. The reduced binocular condition did not create a significant deficit in any of the leaping performance variables ($p>0.05$). However, individuals did significantly decrease the proportion of locomotor time spent leaping when their binocular field was reduced. These results suggest that while a wider binocular field may not be necessary for improved leaping performance, it may influence the extent to which animals rely on leaping over other locomotor modes.

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On the cusp of a distinction: Does molar cusp position distinguish *Homo* from *Australopithecus*?

DOROTTYA E. KENESSEY[1], SHARA E. BAILEY[2,3] and WILLIAM H. KIMBEL[4,5]

[1]Department of Anthropology, New York University, [2]Center for the Study of Human Origins, New York University, [3]The New York Consortium in Evolutionary Primatology, [4]Institute of Human Origins, Arizona State University, [5]School of Human Evolution and Social Change, Arizona State University

Up to 20% of the characters used in cladistic analyses of fossil hominins are dental. Some of these traits are easily quantified (e.g., molar crown area), while others are more prone to subjectivity. An example of the latter is the relative position of the mesial cusps, the protoconid and metaconid, on the lower molars. This study aims to quantify the protoconid:metaconid position because it has been cited as a feature that distinguishes the lower molars of *Homo* (in which the protoconid is more mesial than the metaconid) from those of *Australopithecus* (in which cusps are equally positioned on the crown). We assessed the relative protoconid/metaconid position in three ways: (1) qualitatively, from visual inspection of occlusal photographs; (2) by calculating the ratio of protoconid:metaconid cusp lengths; and (3) by calculating the ratio of protoconid:metaconid cusp areas. Our sample comprised 178 non-antimeric teeth from four early hominin genera: *Australopithecus*, *Kenyanthropus*, *Paranthropous* and *Homo*. We found 90% inter-observer agreement in the assessment of cusp position by visual inspection: in each taxon, a majority of lower molars (>60%) possess a mesially placed protoconid. This subjective result is exceeded by the cusp position ratio, which is < 1.0 (protoconid shorter) in 151 of the 178 teeth included in the study. Finally, we found that the metaconid, but not protoconid, cusp area was strongly correlated with cusp length. In failing to find any taxonomic patterning in the relative position of these mesial cusps, our results contradict previous suggestions that protoconid:metaconid position distinguishes *Homo* from *Australopithecus*.

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A tale of two species: a geometric morphometric analysis of *Macaca fascicularis* and *Macaca mulatta* crania

BRITTANY A. KENYON, MARK A. CONAWY and NOREEN VON CRAMON-TAUBADEL

Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo - SUNY

Research has shown extensive behavioral variation across *Macaca,* likely due to the wide geographic range of the genus. Due to their marked sexual dimorphism, sex can be identified based on cranial and dental size. Recent studies have demonstrated a wide cranial diversity throughout the order Primates, however, cranial shape variants distinguishing species are less clear. The current study sought to test a geometric morphometric protocol for sex and taxonomic identification in *Macaca*, testing the hypothesis that two closely related but geographically and behaviorally distinct species could be identified based on cranial shape. The study utilized 20 *M. fascicularis* and 20 *M. mulatta* (10 adult males and females of each species) that were collected from the UB Primate Skeletal Collection.

29 unilateral cranial landmarks were captured using a MicroScribe G™ digitizer. Intra-observer error was calculated using the average standard deviation of three landmarking trials with

calculated error rates <1mm for each configuration. Landmarks were subjected to a generalized Procrustes analysis and subsequently analyzed using principal components analysis (PCA), canonical variate analysis (CVA), and discriminate function analysis (DFA). Results suggest relatively minor distinctions between males and females based on cranial shape following size adjustment, which is surprising given the degree of sexual dimorphism in *Macaca*. CVA and DFA results were able to partially determine species affinity, suggesting that a geometric morphometric approach to taxonomic classification is feasible. These results suggest that with a larger sample size and the utilization of bilateral landmarks, specific shape traits distinguishing macaque species could be determined.

Levels of selection: Untangling kin and individual signatures in vocalizations

SHARON E. KESSLER[1], LUCIE RIGAILL[2] and SALLY E. STREET[1]

[1]Anthropology, Durham University, [2]Primate Research Institute, Kyoto University

Many mammals, including primates, have socially complex, kin structured societies. The evolution of this social complexity is dependent upon the ability to recognize individuals and kin. Vocal communication is an important modality for this recognition because it can convey information about callers who are out of sight. Individuals are nested within kin groups, meaning that heritable vocal tract morphology and social learning of vocalizations likely limits the degree to which individuals can be distinct from kin. Similarly, individual differences in morphology and vocal development may limit the degree to which individuals within a kin group can converge. Therefore, it is likely that individual and kin signatures evolve in association, making it difficult to determine if and how selection may be acting on each signature type. Numerous studies have investigated whether primate vocalizations are distinctive by individual or kin group (individual or kin group signatures), but the two are rarely addressed together. We predicted that, across species, the signature type under the strongest selection will be most pronounced and that the other signature will evolve in association. We conducted a systematic literature review across mammals and performed meta-analyses comparing the degree to which mammalian vocalizations are distinctive by individual and by kin group. We discuss the variation according to taxa and call types (mating, alarm, agonistic calls, etc.). Fewer studies have been conducted on the effects of kinship than individuality and we make suggestions for future research directions.

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Subsistence and Facial Form: Estimating Masticatory Muscle Mechanical Efficiency in Historical Populations from Northern China

MATTHEW J. KESTERKE[1], LAUREN N. BUTARIC[2], QUN ZHANG[3], TAO HAN[3], HONG ZHU[3], QUANCHAO ZHANG[3] and QIAN WANG[1]

[1]College of Dentistry, Texas A&M University, [2]Department of Anatomy, Des Moines University, [3]Department of Archaeology, Jilin University, PR China

Diet plays a substantial role in shaping human craniofacial morphology, and is often used as an explanatory factor in quantifying and evaluating hominin variation. Novel metric techniques have recently been developed to differentiate between hominin populations based solely on estimates of masticatory muscle efficiency. The advent of agriculture and the resultant changes mechanical loading of the human masticatory complex therefore play a key role in shaping the modern human face. This study evaluates historical skeletal remains with known subsistence patterns from Northern China to test the hypothesis that human populations practicing agriculture demonstrate measurable differences in skull form associated with masticatory muscle mechanical efficiency compared to contemporaneous populations practicing pastoralism and/or hunting-gathering (n= 103). Based on overall muscle volume for muscles of mastication calculated using linear and three-dimensional skeletal measurements, one-way ANOVA tests showed no significant differences between group muscle cross-sectional areas of the medial pterygoid, temporalis, and masseter muscles for the agricultural, pastoralist, and hunter-gatherer samples. However, when coupled with estimates incorporating lever-arms, physiological cross-sectional area, and bite-force lever arm estimates, one-way ANOVA tests demonstrated significant differences in overall masticatory efficiency between the three subsistence patterns ($p=0.030$, $F=5.865$). Traditional bioarchaeological estimates of diet and oral pathology can negatively affect these estimates. These patterns demonstrate that muscle size and volume alone cannot effectively discriminate between subsistence patterns, and that estimates incorporating the entire masticatory complex must be used when evaluating overall mechanical efficiency to assess the adaption and evolution of the craniofacial complex.

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Biomechanical restrictions on Palaeolithic technological decisions: a study of the non-dominant hand

ALASTAIR J. M. KEY

School of Anthropology and Conservation, University of Kent

Palaeolithic stone technologies co-evolved alongside the hominin hand for over three million years. It is widely supported that the production of flaked stone technologies likely contributed to the evolution of human hand anatomy. Increasingly, evidence is indicating that the biomechanical capabilities of the hominin hand may have influenced stone tool production decisions, and in turn, the Palaeolithic archaeological record. Overwhelmingly, these studies have focused on the dominant hand.

Presented here is experimental evidence that demonstrates how the evolutionary history of the non-dominant hand may have influenced the development of Palaeolithic technologies. Manual pressure data were recorded from 12 sensors on the non-dominant hand of nine experienced flint knappers during three tool production strategies; namely, flake and core, hard-hammer handaxe , and soft-hammer handaxe production. In total, pressure data from 2832 flake removal attempts and platform preparation events were recorded. Data revealed significant pressure differences between the three reduction types, however, differences depended on the digit investigated and no strategy consistently required greater loads across all digits. No clear pressure differences were identified between hard and soft hammer percussion. Platform preparation (grinding and retouching) required significantly greater pressures relative to flake removals in all three reductions. In sum, the late Lower Palaeolithic technological strategy of preparing flake platforms requires greater manual pressure than other stone tool production behaviours and may only have been possible with modern human-like forceful precision gripping. Other technological differences between these three reduction types do not, however, appear to have been limited by manual related biomechanical restrictions.

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Native American relatives in Bronze Age southern Siberia? Okunev Culture and the new dialogue of genome-wide ancient DNA and physical anthropology

ALEXANDER M. KIM[1], ALEXANDER KOZINTSEV[2], VYACHESLAV MOISEYEV[2], NADIN ROHLAND[3], SWAPAN MALLICK[3] and DAVID E. REICH[3,4,5]

[1]Anthropology, Harvard University, [2]Peter the Great Museum of Anthropology and Ethnography, [3]Genetics, Harvard Medical School, [4]Howard Hughes Medical Institute, [5]Broad Institute of MIT and Harvard

Genome-wide ancient DNA data from Pleistocene and Holocene Eurasia have posed significant challenges to traditional models of relationships between Native Americans, East Asians, and West Eurasians, situating all of these groups in a complex graph of splits and repeated admixtures

that is strongly at odds with a simple bifurcating tree. Ancient DNA has affirmed the existence of theoretical "ghost populations" such as "Ancient North Eurasians" that were invoked to explain odd patterns in the genetic affinities of present-day populations, but has also provided surprising attestation of groups whose existence was far closer to unanticipated. Physical-anthropological hypotheses, many of them originating in the pre-genomic era, have played an important if often underappreciated role in the motivation and framing of recent ancient DNA work. We evaluate new and existing genome-wide data from Okunev — an archaeological culture of the Middle Yenisei and eastern steppe in southern Siberia (latter third to first half of the second millennium BC) – to evaluate one such hypothesis: that these Bronze Age populations were "collateral relatives" of ancestral Native Americans who persisted surprisingly late in Eurasia. We find compelling partial validation of this notion, present some more complex models capturing other important aspects of these data, and offer some suggestions about the ongoing importance of physical anthropology in the era of genomics and ancient DNA.

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Intra-specific variation in skeletal traits of free-ranging rhesus macaques (*Macaca mulatta*)

CLARE M. KIMOCK[1,2], JAMES P. HIGHAM[1,2], ALEX R. DECASIEN[1,2] and CONSTANCE DUBUC[1]

[1]Department of Anthropology, New York University, [2]New York Consortium in Evolutionary Primatology

Intra-sexual selection is thought to play a significant role in the evolution of sexual dimorphism in body mass and canine size in primates. Sexual dimorphism correlates with levels of direct male-male competition across primate species, but the ways in which sexual selection processes generate intra-specific variation in sexual dimorphism are not well understood. This study investigates intra-specific variation in skeletal traits related to body size and weaponry in free-ranging rhesus macaques, which have reduced levels of direct male-male competition and are less dimorphic than many other macaque species. Linear measurements were collected on skeletons of 297 skeletally mature rhesus macaques that died of natural causes on Cayo Santiago. Skeletal traits were between 10% and 32% larger than in males than in females, but canine size was more dimorphic. Canine base measurements were 49-51% larger in males than in females and canine height was 146% longer in males than in females. Only three of the skeletal traits were more variable among males than females, but all the canine measurements were more variable among males than females. Animal models were used to calculate narrow-sense heritability values for the skeletal traits. Several, but not all, of the skeletal measurements were significantly heritable. These results demonstrate that selection can act on certain skeletal markers of body size and muscle strength in rhesus macaques because variation in these traits has a genetic basis, but that environmental variance contributes significantly to variation in many skeletal markers of muscle strength.

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Isotopic evidence for habitat heterogeneity at Bukwa, an early Miocene catarrhine site in Uganda

JOHN KINGSTON[1], LAURA MACLATCHY[1], SUSANNE COTE[2] and RAHAB KINYANJUI[3]

[1]Anthropology, University of Michigan, [2]Anthropology and Archaeology, University of Calgary, [3]Earth Sciences, National Museums of Kenya

Bukwa, an early Miocene fossil site on the flanks of Mt. Elgon, has yielded a small but diverse assemblage of mammals. Recent fieldwork has provided an opportunity to refine the chronostratigraphy, paleoecological context, and expand the faunal list, including several new primate specimens. $^{40}Ar/^{39}Ar$ radiometric dates on the bracketing lavas indicate an age of ~19 Ma, placing it chronostratigraphically in an intermediate position relative to other early Miocene sites in East Africa. Comparative faunal studies suggest rapid faunal turnover around this time, with Bukwa documenting FADs for a number of immigrant lineages. In order to assess the extent to which environment may be affecting community composition, ecological conditions and possibly selective forces, enamel from a suite of fossil herbivores were analyzed isotopically to constrain dietary paleoecology. The cumulative $\delta^{13}C_{enamel}$ values range from -16.1 to -8.2‰, indicating dietary niches comparable to modern herbivores inhabiting broken canopy forests to open woodland habitats. The more positive $\delta^{13}C_{enamel}$ values (-9 to -8‰) potentially reflect foraging on water stressed C_3 browse along ecotones or at canopy margins where evapotranspiration is high. Alternatively, these values may reflect a C_3 (or C_4) grazing component in the diet, as indicated by high proportions of grass phytoliths (18%) in the paleoflora. Overall, these data are consistent with emerging isotopic data from other early Miocene sites in Uganda and Kenya, indicating that developing catarrhine diversity in East Africa during this time may be linked to habitat heterogeneity generated by vegetation successions along the dynamic flanks of active volcanoes.

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Macaque Attack: The association between dental pathologies and temporomandibular osteoarthritis in *Macaca fascicularis*

CLAIRE A. KIRCHHOFF[1], SIOBHÁN B. COOKE[2,3] and CLAIRE E. TERHUNE[4]

[1]Biomedical Sciences, Marquette University, [2]Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [3]Morphometrics Group, New York Consortium on Evolutionary Anthropology, [4]Department of Anthropology, University of Arkansas

Testing how pathological changes to the dentition covary with temporomandibular joint (TMJ) pathology will improve our understanding of masticatory function and dysfunction. Pathology rates are well documented for humans, but not for other primate species. 84 complete *Macaca fascicularis* (36 females, 48 males) skulls were evaluated for TMJ osteoarthritis, antemortem tooth loss, periodontal disease, dental caries, broken teeth, dental abscesses, tooth crowding/malocclusion, and other craniofacial traumata and pathologies using standard criteria. Fisher's exact tests for differences between males and females as well as variation in pathology rates for animals with and without TMJ osteoarthritis were carried out in SPSS. There were no differences in rates of lesions between males and females ($p = 1.000$-0.187), but there were several differences in pathology rates for animals with versus without TMJ osteoarthritis, including antemortem tooth loss ($p = 0.011$), periodontal disease ($p = 0.002$), broken teeth ($p = 0.002$), and dental abscesses ($p = 0.018$). The rates for dental caries ($p = 0.603$), tooth crowding ($p = 1.000$), trauma ($p = 0.578$), and other pathologies ($p = 0.387$) did not vary by TMJ status. These results suggest an association between at least some kinds of oral lesions and osteoarthritis of the TMJ in *M. fascicularis*. Broken teeth and abscesses likely measure related phenomena. While osteoarthritis is often a sequel to trauma, the rate of trauma in this sample may be too low to detect an association. Further analyses will assess relationships between pathologies and overall craniofacial and dental morphology.

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New Eocene primates from the Tornillo Basin of Trans-Pecos Texas

E. CHRISTOPHER KIRK

Anthropology, University of Texas at Austin, Jackson School Museum of Earth History, University of Texas at Austin

The Tornillo Basin is the southern-most intermontane Laramide basin in North America. Bounded by the Chihuahua Tectonic Belt to the west and the Marathon uplift to the east, the Tornillo Basin documents a range of primate taxa occurring at lower latitudes in the North American Paleogene. Although large in area (approx. 28,000 km^2) the Tornillo Basin is heavily overprinted by Middle

Eocene to Late Oligocene volcanics. As a result, vertebrate fossils are recovered from discontinuous smaller areas of exposure within the basin. Two Middle Eocene primate specimens are known from the Sierra Vieja in the northwestern Tornillo Basin, and a small sample of Uintan primates has been recovered from the Canoe Formation in the southeastern Tornillo Basin. However, the largest sample of Eocene primates has been recovered from the Devil's Graveyard Formation in the south-central portion of the basin. Research in the Devil's Graveyard since 2005 has substantially expanded this primate sample and led to the discovery of the endemic genera *Diablomomys* and *Mescalerolemur*. This presentation documents the presence of two additional new omomyoid species from the Uintan (approx. 44 Ma) Purple Bench locality. In stratigraphic context, these new species provide further evidence of increasing provincialism in the Late Middle Eocene of southwest Texas. Indeed, the primate genera documented in the early Uintan of the Tornillo Basin (e.g., *Omomys*, *Ourayia*) are cosmopolitan taxa known from similar-aged sites in North America. By comparison, all Duchesnean primate genera represented in the Tornillo Basin (e.g., *Rooneyia*, *Mahgarita*) are regional endemics.

The homology of the human pisiform revealed by comparative ossification timing in hominoids

KELSEY M. KJOSNESS and PHILIP L. RENO

Bio-Medical Sciences, Philadelphia College of Osteopathic Medicine

Typical mammalian pisiforms, including non-human primates, are elongated and develop from two ossification centers with an associated growth plate. The human pisiform is unusually short and forms from a single ossification center, raising the question of whether it is homologous to the primary or secondary center of other primates. Orangutans also possess a relatively short pisiform compared to other primates; however, it develop from two ossification centers. The pisiform and calcaneus are paralogous structures in the wrist and ankle, and human calcanei retain two ossification centers with a growth plate. We use a comparative analysis of pisiform and calcaneus ossification timing with respect to dental eruption in juvenile Old World monkeys, apes, and humans (n=922) to better understand the developmental processes underlying the identity of the unique human pisiform. Analyses indicate that human pisiforms develop at approximately the same dental stage as the pisiform epiphyses of other primates, and also developed at the same time as the human calcaneal epiphysis. This evidence supports homology between the sole ossification center of the human pisiform and the pisiform epiphysis of other species, indicating that humans have experienced a major change in skeletal patterning of the wrist through the loss of a primary ossification center and the associated growth plate. Furthermore, since the reduced orangutan pisiform retains two ossification centers and presumably a growth plate, pisiform reduction in these two species are the result of different developmental mechanisms.

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A Re-Examination of Sundadonty Origin Models

SHANNON A. KLAINER and G. RICHARD SCOTT

Anthropology, University of Nevada Reno

The Sinodont and Sundadont dental complexes distinguish East Asians from Southeast Asians. There are two models regarding the origin of Sundadonty: (1) it was a longstanding complex throughout Asia that was ultimately ancestral to the specialized Sinodont complex in northeast Asia; and (2) it arose through gene flow between East Asian Neolithic farmers (Sinodonts) and Austral-Melanesians, the original inhabitants of Southeast Asia. To address these models, frequencies were analyzed for 23 crown and root traits in 15 groups from East Asia, Southeast Asia, Polynesia, Micronesia, and Australia using the Mean Measure of Divergence distance statistic and cluster analysis. Two distinct clusters were found. The first cluster includes four Australian populations, differentiated at a high level from all Asian populations. The second cluster shows two major subclusters: the first contains five East Asian groups, with Japan linked tightly with Mongolia (Urga) and north China (An-yang) while the second includes ten Southeast Asian and Pacific populations. In Japan, modern Japanese exhibit the Sinodont pattern while the ancient Jomon and recent Ainu exhibit Sundadonty. It seems unlikely that the Sundadont pattern was a product of Sinodont X Austral-Melanesian admixture given that the earlier populations of Japan and the widely dispersed populations of the Pacific were all Sundadonts. The pattern of dental variation is more consistent with the idea that Sundadonty is an ancient dental complex in Asia that was ancestral to the Sinodont complex that arose in north Asia during the late Pleistocene.

Introducing MorphoPASSE: the Morphological Pelvis and Skull Sex Estimation Database

ALEXANDRA R. KLALES[1] and STEPHANIE J. COLE[2]

[1]Forensic Anthropology Program, Washburn University, [2]Department of Anthropology, University of Nevada, Reno

Bioarchaeologists and forensic anthropologists continue to utilize morphological methods for the estimation of sex in unidentified human skeletal remains. The most popular traits used for the estimation of sex in both forensic and archaeological contexts are the five traits included in the Walker (2008) method (supraorbital margin, glabella, nuchal crest, mastoid process, mental eminence), and the three Phenice (1969) traits included in the Klales et al. (2012) method (ventral arc, subpubic contour/concavity, medial aspect of the ischiopubic ramus). These eight traits were collected for over 2,800 individuals from various U.S. and international skeletal collections for the development of the free, interactive morphological database, MorphoPASSE: Morphological Pelvis and Skull Sex Estimation. Individuals from both modern and historic populations were included. The MorphoPASSE package interfaces with R to conduct the statistical tests and the results are displayed in a user-friendly format with associated statistical probabilities. Practitioners can enter their trait scores into the program, select the appropriate reference population (temporal and ancestry group), and the program will determine the sex probability based on those traits using logistic regression analyses. A publicly available user manual and website (www.MorphoPASSE.com) have been created to accompany the database and to facilitate the use of these traits for reliable and valid sex estimation. The score data from this research is available in numerous formats, including a CSV file and an R package.

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Beyond Contact: Clark Spencer Larsen and the Bioarchaeology of Colonial Worlds

HAAGEN D. KLAUS

Sociololgy and Anthropology, George Mason University

The singular influence of Clark Larsen on contemporary bioarchaeology has shaped many areas of study, but perhaps none more than the bioarchaeology of culture contact and colonialism. Until the 1980s, anthropologists, social scientists, and the general public entertained notions of contact as occurring only in the post-A.D. 1492 New World between Native Americans and involved inevitable native demographic decline and uniform cultural collapse. This poster explores the foundational effects of Larsen's work on the bioarchaeology of contact beginning with his diachronic studies of the Georgia Bight. Larsen's work tested long held assumptions to demonstrate that contact resulted in far more complex and diverse outcomes – up-ending orthodoxy and sparking other scholars and his students to reconstruct the biocultural effects of contact throughout the Western Hemisphere. A systematic review of the literature shows that a first wave of foundational bioarchaeological contact

studies began in 1992, while a second wave (which built directly upon the first) emerged in the mid 2000s. Throughout these diverse works, Larsen's multiple trajectory-setting influences were reflected in the ever-increasing horizon of questions including extension of "contact" to the colonizers and to non-western or non-Columbian settings, simultaneous study of multiple lines of evidence and employment of cutting edge methods, collaborative research designs, and new theoretical applications. Once envisioned as a deterministic and one-dimensional phenomenon, Clark Larsen's work has humanized anthropological studies of contact and colonialism to reveal in ever-growing and surprising detail what was perhaps most complex adaptive transition of our species – and that continues to unfold.

Dermatoglyphic markers are predictors of reproductive success in women

MAGDALENA KLIMEK, ANDRZEJ GALBARCZYK, ILONA NENKO and GRAZYNA JASIENSKA

Department of Environmental Health, Jagiellonian University Medical College, Krakow, Poland

Dermatoglyphic characteristics are under genetic and environmental (including sex hormones) influence, and are biomarkers of early developmental conditions. Dermatoglyphics are related to many diseases, including reproductive cancers (breast, cervix) in women. Here we analyze, for the first time, the association between two dermatoglyphic biomarkers and women's reproduction (First Birth Interval, number of children, age at first and last birth, mean interbirth interval and reproductive span). The participants were 237 women aged 45-92 (mean=61.6; SD=11.18) from rural population with natural fertility at the Mogielica Human Ecology Study Site in Poland. Two dermatoglyphic indices: AFRC (absolute finger ridge count, total amount of ridge counts in both hands) and Md15 (difference between mean number of ridge counts on thumbs and little fingers between hands) were calculated according to standard procedures. Age, education, age at marriage, age at first birth, mean interbirth interval and husband's age at marriage were included as covariates, depending on the analysis. AFRC was negatively related to First Birth Interval (borderline significance p=0.07), number of children (p=0.02), age at last birth (p=0.03) and reproductive span (p=0.02). Md15 was negatively related to reproductive span (p=0.02). No statistically significant associations were observed for age at first birth and mean interbirth interval. Our results suggest that more favourable early environmental conditions, reflected in lower values of AFRC and Md15 indices, are related to women's higher reproductive success. This study adds to the growing body of evidence that early developmental conditions are important for shaping later life.

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Human evolution and cultural flexibility in a time of climate change

MICHELLE A. KLINE

Psychology, Simon Fraser University

Changing climate has always shaped human capacities and life ways, including the advent of agriculture during the Holocene. The reverse is now also true, and on a faster time scale: human life ways are changing Earth's climate and contributing to a global sustainability crisis. Norms of consumption, resource use, and technological change are all cultural phenomena that have contributed to this crisis. Since culture helped humans create this mess, a better understanding of cultural adaptation and transmission may help to mitigate it. Data from marine foraging toolkits in Oceania show that population size and connectedness contribute to the increasing complexity of subsistence toolkits (ß=.805, p=.005). Evidence from a small-scale population in Fiji shows that there are patterns in how knowledge is acquired: skills learned early in life are learned from parents (OR=.83, p=.001), as opposed to experts or other kin, and are likely to be general, low-skill tasks (r=.59, p=.000). These basic findings are building blocks for explaining how current systems of resource exploitation—sustainable or not—come to be. An open question in sustainability systems research is whether cultural evolution can produces sustainable solutions to resource use. To address that question, this talk concludes with a methodological framework for assessing the relative importance of group- and individual- level cultural selection. Further, the talk illustrates the logic of this framework using qualitative historical evidence from fisheries management in Fiji and introduces a tutorial for quantitative work.

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Beyond group size effects: vigilance and social monitoring in Nepal gray langurs

KATHERINE J. KLING[1] and ANDREAS KOENIG[1,2]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University SUNY, [2]Department of Anthropology, Stony Brook University SUNY

Primate vigilance may serve to avoid both predator and conspecific threats. Group size is shown among many non-primate species to mediate individual vigilance effort, yet primates display an absence of a group size effect, a result potentially explained by vigilance's multiple functions and a common lack of distinguishing these functions in many studies. To examine these possible influences, we conducted a study of vigilance and social monitoring in Nepal gray langurs (*Semnopithecus schistaceus*) which both distinguished vigilance targets and considered its functions. Focal instantaneous data was collected (N=160 observation days) from two groups (N=27 adult individuals) in Ramnagar, Nepal and analyzed using linear mixed effects models that used group membership, proximity, and reproductive seasonality as effects on vigilance and social monitoring. The lack of a group size effect (P>0.05) for vigilance, in conjunction with higher vigilance when neighbors were absent (P<0.01), suggested the importance of perceived, rather than overall, group size. Higher vigilance effort occurred among males (P<0.01) and, for mothers, when young offspring were present (P<0.001), suggesting an anti-predator function of vigilance. Higher social monitoring was exhibited among males during the mating season (P<0.001), for mothers in proximity to their young infants (P<0.001) and within the larger group (P<0.02), supporting the notion of differential priorities for males and females to monitor competitors and to avoid conspecific threats. The evidence for varying functions of vigilance and social monitoring within this species and across group demographics emphasizes the importance of distinguishing vigilance targets.

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Jaw muscle positions facilitate gape-specific feeding strategies in platyrrhines

ZACHARY S. KLUKKERT

Doctoral Program in Anthropology, City University of New York Graduate Center, New York Consortium in Evolutionary Primatology (NYCEP)

Variation in the musculoskeletal anatomy of primate jaws is understood to be influenced by feeding behavior, phylogeny, and body size. Jaw shape and muscle anatomy act together in life, but are typically studied apart. The discrete components of the masticatory complex provide useful insights into feeding adaptations and trends in primates. Using 3DGM, platyrrhine mandibular morphology was found to distinguish taxa, though functional attributes relating to diet account for most of the variance. Functional metrics of jaw muscles are reported to scale with size, and are less sensitive to phylogeny or diet. Here, both components are integrated to model the effect of variability in jaw shape on muscle performance with gape. Patches of virtual 3D

landmarks were applied to the attachment sites of jaw-closing muscles on 3D models of skulls using Landmark software. The distances between attachments were measured with skulls set to different gape configurations, then length-tension formulas and PCSA data from the literature were used to model muscle force in each position. Results show that variation in muscle position with respect to the jaw joint produces a pattern of heterogeneous excursion that distinguishes each muscle. In three taxa, two patterns using combined-musculature are found, and are consistent with the prioritization of bite force at low-gape (*Ateles* and *Cebus*) and high-gape positions (*Chiropotes*). These results are also consistent with the physical properties of the foods eaten by these taxa, and suggest the presence of a mechanical compromise between the requirements of masticating small resistant foods vs. ingesting larger foods.

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Mitochondrial population dynamics in Black Death London

JENNIFER KLUNK[1,3], ANA DUGGAN[2,3], REBECCA REDFERN[4], SHARON DEWITTE[5] and HENDRIK POINAR[1,2,3]

[1]Department of Biology, McMaster University, [2]Department of Anthropology, McMaster University, [3]McMaster Ancient DNA Centre, McMaster University, [4]Centre for Human Bioarchaeology, Museum of London, [5]Department of Anthropology, University of South Carolina

In this study, we examine the hypothesis that the period of time spanning the Black Death was a period of high migration into the city of London, England through mitochondrial DNA evidence. Previous studies using paleopathological and stable isotope evidence have identified the presence of potential migrants in several cemetery sites in London and have suggested that urban-to-rural migration was prevalent, especially in the period directly following the mass mortality event of the Black Death. Using a novel sequential-enrichment strategy, full, high-quality mitochondrial genomes were recovered from 132 individuals buried in three sites in London from the 11th century to the 16th century. Grouping the individuals into populations by time period (before, during, and after the Black Death) and by cemetery, we find no statistically significant genetic difference between the populations. Further subdividing the populations based on sex, there is still no statistically significant genetic difference between populations. This indicates that either there was no large female population movement into the city of London over the time period of the Black Death or that the populations from which potential migrants came were not genetically distinct from the urban London population.

One genome, two phenotypes: A multi-disciplinary perspective on sexual dimorphism

LESLIE A. KNAPP

Anthropology, University of Utah

Darwin described many striking, often ostentatious, examples of sexual dimorphism in animals. He proposed that sexual selection, resulting from variation among individuals in mating success, could explain the evolution of extravagant sexual dimorphism. This argument is well-known, but the question remains: How do sex-specific phenotypes arise from a genome that is largely identical in both sexes?

The evolutionary interests of males and females conflict. Both sexes aim to optimize their reproductive success, but their genetic interests are not aligned. Their conflict is thought to be the result of gamete dimorphism and each sex's distinct reproductive role, i.e., divergent selection pressures. Conflict also results because genes that are evolutionarily favored in males are disfavored in females and vice versa. Independent evolution in sexes is limited by their shared genome and the common mechanisms controlling trait expression.

The basic question of how to produce two different organisms from the same genome, with effectively the same set of genes, has been a long-standing and fundamental question in evolutionary biology. Presence, or absence, of a Y chromosome contributes to differences in the development of each sex, expression of genes and hormones that contribute to dimorphic phenotypes. There is consensus that the androgen receptor gene, on the X chromosome, regulates gene expression differently in males and females. Experimental studies show that androgen receptor gene expression can be modified by DNA methylation. Beyond sex chromosomes, recent research also indicates that autosomal loci play a role in sexual dimorphism, particularly with respect to gene expression.

The impact of changing religious practices on orangutan fieldwork and conservation in West Kalimantan (Borneo), Indonesia

CHERYL KNOTT[1,2], CAITLIN A. O'CONNELL[1], TERRI BREEDEN[2] and TRI WAHYU SUSANTO[2]

[1]Anthropology, Boston University, [2]Gunung Palung Orangutan Conservation Project

Primate field projects are often under the direction of foreign researchers, who live and work alongside members of local communities. Here we discuss the impact of religion on orangutan research and conservation in Gunung Palung National Park, Indonesia over the past 25 years. We demonstrate how our local staff integrates orangutan conservation with religious practices. This includes sharing Islamic prayers on the responsibility of humans to safeguard nature, and the breaking of the fast during Ramadan with villages that are our conservation partners. Islam prohibits the eating of orangutans (as well as forest pigs). In contrast, the indigenous Dayak communities of Borneo historically do hunt and eat orangutans. This impacts the current orangutan distribution. At the Cabang Panti Research Site we have been recording the presence of hunters within our trail system, as well as the number of gunshots heard, since 2008. We find that there is a significant association between these occurrences and the end of the fasting month of Ramadan. We discuss changing religious values and how increasingly conservative practices affect foreign researchers, particularly women. We also detail how social media can help researchers become better informed about important local issues. For example, through our data collection we became aware that local people may be consuming wild pig meat around religious holidays, potentially unknowingly. Social media made us aware that local communities were concerned about this issue, which also impacts wildlife conservation, and thus we can tailor our outreach efforts to meet this intersection between religion and conservation.

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Learning to Live Together: Social Tolerance and violence at Neolithic Çatalhöyük (7100-6000 cal BC)

CHRISTOPHER J. KNÜSEL[1], BONNIE GLENCROSS[2] and MARCO MILELLA[3]

[1]UMR 5199 PACEA, University of Bordeaux, [2]Department of Archaeology and Heritage Studies, Wilfrid Laurier University, [3]Department of Anthropology, University of Zurich

The Neolithic of the Near East is characterized by innovations in subsistence strategies, expanded social networks, long distance exchange, and increased population densities. Greater cooperation and increased social tolerance between individuals and communities is required to sustain these socio-cultural changes. Less often addressed are those social mechanisms by which aggressive behavior is mediated. One factor is the advent of a social dynamic regulating intolerant behavior, including discrimination, marginalization, and violence.

Here, we explore the subtle equilibrium between social tolerance and violence in the densely populated Neolithic community of Çatalhöyük, Central Anatolia, Turkey. A total of 34 individuals (18 females, 10 males, 6 indeterminate) exhibit 54 cranial injuries with the majority due to blunt force trauma. Those areas of the cranium

showing the greatest number of injuries include the occipital and parietals towards the posterior of the cranium, as well as the frontal. Most of the individuals date to occupation levels of showing high fertility and the greatest population densities. There are also three individuals who are found in midden or infill after abandonment of buildings, locations that stand in contrast to the much more common subfloor or platform burials at the site. By means of a joint analysis (N = 152) of age and sex ratios, cranial trauma, and funerary practices, this study documents the multifaceted expression of social tolerance at the site, and demonstrates the increasing relevance of violence as a mediating social mechanism during human biocultural evolution.

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Reanalysis of the Trotter Collection for a Study on Variation in Human Hair

SANDRA KOCH, NINA JABLONSKI and MARK D. SHRIVER

Anthropology, Pennsylvania State University

Human scalp hair is a visible trait that varies both within and between populations, and is a potential source of forensic information. Mildred Trotter's early twentieth century studies of hair form, growth, somatic distribution, racial characteristics, and sex differences provide a foundation for understanding differences in hair forms among humans. Her studies documented variation in hair (color, shape, and size) among human populations, but needs to be updated in regards to her use of racialized terminology and to focus on intraindividual variation. Here we report on new morphological research of intra-individual, intra-group, and inter-group variation in human scalp hair form and microstructure using hairs from the Trotter Collection. Using current microscopical and image-analysis methods we were able to update the quantitative measurements Trotter made from hair cross-sections. We examined variation in hair size and shape, and the distribution of pigment-containing melanosomes using oil immersion microscopy (1000x magnification), ImageJ, and QGIS. 60 hair samples representing 25 populations were cross-sectioned and area and ellipticity calculations were compared to Trotter's data. Mapping the distribution of melanosomes revealed variability in distribution and percent of area occupied by the organelles. Variation in these parameters was greater within single individuals than between individuals or groups. Hair shape did not distinguish hairs well by geographic ancestry, and was found to be more continuously distributed across populations. These findings support the elimination of typological racial identifiers in classificatory and forensic contexts, and supports the need for additional research on the effects of genetic admixture on hair traits.

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Morphological integration in macaque limb development: implications for understanding human development

LUCI ANN P. KOHN[1], BRYAN RICCI[1], JEAN E. TURNQUIST[2], MATTHEW J. KESSLER[3] and JOHN D. BERARD[4]

[1]Biological Sciences, Southern Illinois University Edwardsville, [2]Caribbean Primate Research Center, University of Puerto Rico, [3]Office of Laboratory Animal Resources, West Virginia University, [4]Veteran's Administration, Veteran's Administration

Primate limbs perform a variety of functions, and normal development of their functional components is necessary for their function. Genetic and environmental developmental factors influence limb form, the coordination of dimensions between serial limb elements, and coordination of homologous components between upper and lower limbs. Morphological integration, or the association between functionally or developmentally related structures, provides insights into limb development and evolution. This study examines morphological integration within- and between limb elements in rhesus macaques (Macaca mulatta) through the growth period and in adult limb. We expect that traits influenced by common functional or developmental factors will be more highly correlated with each other than traits that are unrelated.

Lengths of arm, forearm, hand, thigh, leg and foot were measured on 661 newborn through adult Cayo Santiago M. mulatta. Limb elements of an additional 275 adult rhesus macaque skeletons, all from known genealogies, were also recorded. The hypothesis that there is significant pattern of correlation between serial elements within-limbs and between homologous elements between-limbs was tested on the cross-sectional sample of growing macaques, and on living and skeletal adult macaques using a Mantel test.

There is limited significant morphological integration between serial skeletal elements within limbs at each age through the growth period. Significant morphological integration between homologous distal elements is found through much of the growth period, as well as between the forearm and leg in adults. Disruption of significant associations through dysmorphic processes may be expected to have a significant effect on limb function.

Digitizing the Nissen/ Riesen Chimpanzee Longitudinal Radiographic Series

NIKKI KOLL, AHMED LAMEESAH and NATHAN E. THOMPSON

Department of Anatomy, NYIT College of Osteopathic Medicine

While there has been a long-standing interest in anthropology in non-human primate growth, particularly in apes, few long-term longitudinal and cross-section studies of growth exist in chimpanzees from a radiological set of images. One such study was that of Nissen and Riesen started at the Yerkes Primate Center in 1939, which chronicled the growth of a group normal captive chimpanzees until 1975. This radiological dataset capture whole-body growth from birth until adulthood and, in some cases, death. This work has resulted in an invaluable source of long bone growth curves, timings of ossification center appearance, and dental development, though much anatomical and developmental data remains to be gleaned from this dataset.

Here we have curated and digitized the known original x-ray films from this dataset, many of which have been progressively deteriorating. In total, we digitized 2,231 X-ray photographs from 11 of the original 16 chimpanzee subjects (8 male and 3 female) using a Nikon D750 full frame camera and lightbox. While subjects originally had X-ray images taken at consistent (1, 2, 6, or 12 month) intervals beginning at birth, for some subjects large portions of the original dataset have been lost.

This dataset will be made freely available online, and will provide a valuable source for future research involving baseline growth data, *in vivo* data on articulations/configurations of skeletal elements, and patterns of ossification in chimpanzees compared to humans, and may also serve as a tool to age fossil hominin material.

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Unique forms of locomotion in Swartkrans hominins: An analysis of the trabecular structure of the first metatarsal

KLARA KOMZA[1,2], TRACY L. KIVELL[2,3] and MATTHEW M. SKINNER[2,3]

[1]Department of Anthropology, University of Toronto, [2]School of Anthropology and Conservation, University of Kent, [3]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology

Changes in first metatarsal (MT1) morphology within the hominin clade are crucial for reconstructing the evolution of a forefoot adapted for human-like gait. Here we test whether trabecular structure in the MT1 reflects different loading patterns in the forefoot across extant great apes and humans, and within this comparative context, infer locomotor behaviour in two fossil

hominin MT1s from Swartkrans, South Africa. Microtomographic scans were collected from the MT1 of 6 orangutans, 10 gorillas, 10 chimpanzees, 11 modern humans, as well as SKX 5017 (*Paranthropus robustus*), and SK 1813 (taxonomic affiliation uncertain). Trabecular structure was quantified within the head and base using a 'whole-epiphysis' approach with medtool 4.2. We found that humans displayed relatively higher bone volume fraction in the dorsal regions of the bone and higher overall degree of anisotropy (DA), whereas great apes showed the opposite condition. Overall trabecular structure within the MT1 reflected dorsiflexion in modern humans and plantarflexion in great apes. Both fossils displayed low DA, with SKX 5017 showing a hyperdorsal distribution of trabecular bone in the head that is within the range of humans, while SK 1813 showed a distinct trabecular distribution not seen in any other taxon. We suggest that *P. robustus* adopted habitual bipedalism characterized by hyperdorsiflexion at the metatarsophalangeal joint; although it is unclear to which locomotor behaviour this was linked. Whilst low DA in both fossils suggests increased mobility of the MT1, differences in their trabecular distributions imply variable locomotion in Plio-Pleistocene hominins.

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Markov Chain Monte Carlo methods in human skeletal identification

LYLE W. KONIGSBERG and SUSAN R. FRANKENBERG

Anthropology, University of Illinois at Urbana-Champaign

Markov Chain Monte Carlo (MCMC) methods are applicable in human skeletal identification and evidentiary settings whenever numerical integration is too onerous a task. This is particularly true in situations where one wants to calculate a Bayes factor, one needs to integrate across a multidimensional aging method that accounts for inter-correlation, or one needs to obtain a posterior predictive distribution. Although we show examples of the first two problems, we focus especially on the third problem of obtaining posterior predictive distributions. Discriminant function analysis takes a Bayesian approach in calculating posterior probabilities, but then turns frequentist in calculating "typicalities." We show that the Bayesian approach can be maintained by using MCMC to find posterior predictive distributions for the original measurements of a given case. To do this, we use Darroch and Mosimann (1985) shape variables for the first eight craniometric variables in W.W. Howells' dataset for the Buriat and Easter Islanders. We then average the centroids for these two samples to create a test case. On a linear discriminant function this "average cranium" has posterior probabilities of 0.5 and 0.5 given priors of 0.5 and 0.5. The typicalities produce p values that are far below 0.0001. Using MCMC with an uninformative dirichlet prior for group membership, a Wishart prior for the pooled variance-covariance matrix, and multivariate normals for the group centroids, the posterior probabilities of group membership are 0.5 and 0.5. More importantly, the "average cranium" has measurements that are virtually identical to the means from the posterior predictive distributions.

Mechanical Properties Predict Nutritional Quality in Kenyan Savannah Plants

ABIGALE KOPPA[1], OLIVER C.C. PAINE[2], JENNIFER N. LEICHLITER[2] and MATT SPONHEIMER[2]

[1]Department of Ecology and Evolution, Stony Brook University, [2]Department of Anthropology, University of Colorado Boulder

Plant foods high in fiber and mechanical toughness are considered to be nutritionally poor dietary resources for most mammals, particularly primates. C4 savannah grasses are generally regarded as being both tough and high in fiber. Yet, isotopic data suggest high C4 consumption in early hominins, most notably in *Paranthropus boisei* and *Australopithecus bahrelghazali* (up to 80% of total dietary consumption), with *P. robustus* and early *Homo* displaying more mixed C3/C4 diets. Modern primates, including *Papio cynocephalus* and *Theropithecus gelada*, also consume high levels of C4 resources. The most abundant, and often most diverse, C4 foods available within savannah habitats are grasses, which therefore represent a plentiful, easily obtained potential food source. This project investigated the nutritional and mechanical properties of wild, abundant C4 plant species from Amboseli National Park, Kenya. Plant samples were collected across different microhabitats, including open woodland, grassland, and wetland during the wet and dry seasons. Mechanical tests were performed on fresh material in the field while traditional laboratory methods were employed to nutritionally analyze dried samples. Grass species displayed high variability in both nutritional quality and mechanical toughness, and toughness was shown to be a strong predictor of fiber, protein, and overall energy content. This study provides some of the first evidence in wild plants that mechanical properties act as a signal of nutritional quality, a frequently suggested but rarely demonstrated phenomenon. This relationship has the potential to affect modern primate foraging decisions and inform early hominin dietary models.

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Investigating socioeconomic status in historic Charleston, through dietary analysis of urban *Sus scrofa*

REINA B. KORNMAYER, JENA CAIAZZA and CHELSEY JUAREZ

Sociology and Anthropology, North Carolina State University

Stable carbon and nitrogen isotopic analyses can be utilized to investigate dietary differences in protein consumption and trophic level. When this analysis is applied to animals raised for food, dietary differences in kept animals may reflect diversified husbandry practices and the socioeconomic status of owners. Carbon and nitrogen isotopes from thirty-six samples of *Sus scrofa* bone fragments from six archaeological sites (five high SES and one lower SES) dating from 1700 through the late 1800s in Charleston, South Carolina were made available from the Charleston Museum for study. The primary hypothesis is that bones of pigs from low SES sites would be statistically distinct from high SES sites. Namely, urban pigs from low SES localities would have higher $\delta^{15}N$ values reflecting the incorporation of table scraps including meat products in the diet, while rural free range pigs would have lower $\delta^{15}N$ reflecting a diet mix of C_3/C_4 vegetables. In contrast to the 2015 study by Reitsema and colleagues on *Bos taurus* remains from the same time period and location, this study found that there were no statistically significant differences between individual sites in $\delta^{13}C$: $F(5,30)=1.030$, $p=0.418$; or $\delta^{15}N$: $F(5,30)=0.912$, $p=0.487$ or time periods (1700s vs. 1800s). This finding suggests that both low SES and high SES pigs were fed similar diets possibly indicating an established animal husbandry practice for pork that obscured differences in SES between owners or localities.

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The Social Function of Male Embracing in wild black and gold howler monkeys (*Alouatta caraya*)

MARTIN M. KOWALEWSKI[1], MARIANA RAÑO[1], SOL GENNUSO[1] and PAUL A. GARBER[2]

[1]Estacion Biol. Corrientes - MACN BR, CONICET-Argentina, [2]Department of Anthropology, University of Illinois – Urbana

Theories of primate reproductive ecology and social strategies have suggested that in species that form multimale-multifemale social groups, adult males are expected to compete aggressively for access to fertile females while investing less time and energy in intrasexual cooperative and affiliative behaviors. In this study, we describe the behavior and social function of male embracing in *Alouatta caraya,* a species of dichromatic howler monkey. In 2004, we collected data on two neighboring multimale multifemale groups (number of adult males per group were 3-4 and

number of adult females averaged 3-4) over a 12-month period in Northern Argentina. During the study period, 2,390 hr of quantitative behavioral data (approximately 1,195 hr per group) were collected. We found that adult males embraced at a rate of 0.03 occurrences per male observation hr (total of 129 embraces); 71% during intergroup encounters, 13% during howling without intergroup visual contact, 11% during periods that resulted in a change in resident male social hierarchy, and 5% during dyadic male excursions to the borders of the group's range. Our results indicate that male embracing occurred during events associated with increased extra-group threat and group tension. We conclude that the primary function embracing among resident male howler monkeys is to reaffirm bonds of social affiliation during intergroup encounters, as well as to reduce tension or arousal that could lead to within-group aggression. The functions of male embracing across atelines are discussed.

The Leakey Foundation, The Wenner- Gren Foundation, American Association of Primatologists, University of Illinois, Ideawild Inc

Orangutan Growth and Development Evaluated in Conjunction With Secondary Sexual Characteristics

ALEXANDRA E. KRALICK

Anthropology, University of Pennsylvania

Adult male orangutans are polymorphic, with adult males as either flanged with secondary sexual characteristics or unflanged with arrested secondary sexual characteristic development. The factors that mediate the developmental arrest are poorly understood and the effect on bone and dental development remains unexplored. This study examined the relationship between skeletal epiphyseal development, dental development, and secondary sexual characteristics, using the collection of skins, skulls, and skeletons at the Smithsonian National Museum of Natural History (n=44). Skins were visually examined for flanging, CT scans of skulls were staged for dental development according to the Kuykendall (1996) standards, and photographs of long bones that characteristically fuse late in hominoids were staged according to a three-stage system of fused, fusing, and unfused. Similar to chimpanzees, and distinct from humans, results indicate that orangutans exhibit delayed skeletal growth relative to dental growth. Although all skeletally and dentally mature males were flanged, skeletal and dental maturation in young males does not predict flanging. For example, two flanged males were dentally and skeletally young and one flanged male was dentally old but skeletally young. Unflanged males could be young or old dentally, but were skeletally young. Secondary sexual characteristics do not predict skeletal and dental maturation. This reinforces the importance of orangutan conservation for further understanding the maturation patterns that mediate these reproductive strategies. These orangutan data add to our understanding of orangutan dental and skeletal development and provide a basis for further comparison between extant apes and humans.

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Demonstrating Growth and Family Size Tradeoffs: Statistical vs Biological Significance

KAREN L. KRAMER[1], AMANDA VEILE[2] and ERIK OTAROLA-CASTILLO[2]

[1]Anthropology, University of Utah, [2]Anthropology, Purdue University

Early childhood growth has many downstream effects on health and reproduction and is an important measure of offspring quality. While a quantity-quality tradeoff between family size and child growth outcomes is theoretically predicted, empirical evidence is mixed. This is often attributed to phenotypic variation in parental condition. However, inconsistent study results may also arise because family size confounds the potentially differential effects that older and younger siblings have on children's growth. Additionally, inconsistent results raise questions about how to interpret statistical versus biological significance. This paper addresses these concerns by tracking children's monthly gains in height and weight from weaning to age five in a high fertility Maya community (n=75 children, 1571 measurements). We predict that 1) as an aggregate measure family size will not have a major impact on child growth during the post weaning period, but that 2) competition from the birth of a sibling will negatively impact child growth. Accounting for parental condition, we use linear mixed models to evaluate the effects that family size, younger and older siblings have on children's growth. Congruent with expectations, it is younger siblings that have the strongest detrimental effect on children's growth. However, while we find statistical evidence of a quantity/quality tradeoff, the biological significance of these results is negligible. Our findings help to resolve why conclusions about the effect of family size on child outcomes have been inconclusive. Importantly, we suggest that biological significance has been underreported but is essential to demonstrate life history tradeoffs and relationships.

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Hominin proximal femur morphology: three-dimensional finite element analysis of femoral neck strain

PATRICIA ANN KRAMER[1,2] and ADAM D. SYLVESTER[3]

[1]Anthropology, University of Washington, [2]Orthopaedics and Sports Medicine, University of Washington, [3]Center for Functional Anatomy and Evolution, The Johns Hopkins University

One of the diagnostic characteristics of hominin bipedalism is the asymmetric distribution of cortical bone in the femoral neck. Other aspects of hominin femoral morphology, however, vary considerably across space and time. To explore the ramifications of this variability on the structural capacity of the proximal femur, we morphed a previously produced finite element model (FEM) of a modern human femur to reflect the morphology of early hominins.

We selected four features of early hominin proximal femora to model: head size and neck length, angle, and cross-sectional shape. We created morphs by virtually manipulating a surface model of the FEM to reflect published values of relevant early hominin femoral metrics. The FEM was warped using a thin-plate spline interpolation function calculated from the original and manipulated surface models. We applied loads representing heel strike, mid stance and toe off points in the gait cycle and carried out a linear static analysis in HyperWorks (Altair Corp.) which produced von Mises strains at nodal locations.

All morphs demonstrated increased average strains over the human configuration. We found that, unsurprisingly, increasing the length of the femoral neck or decreasing the size of the head increased strains on average by 9%. Decreasing the neck shaft angle increased strains by 14%, while anteroposterior flattening in the femoral neck increased strains by 5%. The change in strain exhibited patterning, with increasing tension found consistently on the superior femoral neck and increasing compression on the inferior neck.

Applying Geostatistics and a Bayesian Assignment Model to Unidentified Migrants Recovered Along the US-Mexico Border

ROBYN T. KRAMER

Anthropology, Texas State University

This presentation seeks to determine how undocumented migrants fit into the established models by using existing coarse-grained baseline strontium and oxygen isoscape models. Another goal is to determine if using a Bayesian assignment method for the dual-isoscapes can aid in estimating most likely regions of geographic residence for unidentified deceased migrants recovered along the US-Mexico border. The hypothesis is that the dual-isotope isoscape and assignment method can be used to estimate region of origin for deceased migrants recovered along the US-Mexico border and improve the probability of making positive identifications by reducing the potential matches for unknown cases within the NamUs database. Recently developed bedrock, water catchment, and soil strontium isoscape models for Mexico, Central

America, and the Caribbean are adjusted using bioavailable strontium ($^{87}Sr/^{86}Sr$) data collected from a variety of published sources. An oxygen (^{18}O) precipitation isoscape obtained from the Global Network of Isotopes in Precipitation online database are trimmed to the area of interest. Using the Operation Identification collection at Texas State University, dental samples (preference is given to maxillary premolars) are collected from five individuals (n=5) and analyzed for strontium and oxygen. Strontium and oxygen isotope values extracted from the teeth are run through a likelihood assignment model established in previous publications produces probability densities in the form of heat maps for the most probable regions of residence for each sampled individual. This research is important because it sheds light on the humanitarian crisis and promotes interdisciplinary approaches and collaboration for forensic identification and human rights issues.

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The progression of vertebral osteoporosis: correlations between vertebral pathological conditions and sociodemographic risk factors

JENNIFER A. KROLL[1] and SEAN D. TALLMAN[1,2]

[1]Anatomy and Neurobiology, Boston University School of Medicine, [2]Anthropology, Boston University

This study examines the possible correlations between vertebral osteoporosis, spondylolysis, Schmorl's nodes, vertebral osteoarthritis, osteophytosis, and laminal spurs. Further, this study examines the effects of sex, age, ancestry, and occupation on the vertebral pathologies. A total of 238 individuals (54 African Americans and 184 randomly selected European Americans) from the William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville, were analyzed. Vertebral pathologies and anomalies were assessed using visual morphometric scoring methods outlined in previous research. It is hypothesized that positive correlations exist between osteoporosis and other vertebral pathologies and a positive correlation exists between vertebral pathologies and strenuous occupations. It is also hypothesized that there is a difference in the prevalence of vertebral pathologies between European American and African American ancestries due to African Americans generally showing higher bone mineral density than European Americans. The results of this research demonstrate numerous relationships: males are correlated with osteoarthritis, and Schmorl's nodes, while females correlated with spondylolisthesis (p-value of 0.001); European Americans are correlated with osteophytosis, Schmorl's nodes, and laminal spurs, while African Americans correlated with osteoarthritis; individuals 40 years or older are correlated with osteoporosis, osteoarthritis, Schmorl's nodes, osteophytosis, and laminal spurs; and lastly, labor intensive occupations (for example, a construction worker) are correlated with osteoporosis, osteoarthritis, osteophytosis, Schmorl's nodes, and laminal spurs, with all p-values less than 0.05. This research demonstrates how pathological conditions correlate with sociodemographic risk factors, which can help with the identification process of skeletal remains in an archaeological and forensic frameworks.

Experimental dental microwear textures with implications for Neandertal diet

KRISTIN L. KRUEGER[1], EVAN CHWA[1], ALEXANDRIA PETERSON[2], RALPH DELONG[3], ALEX FOK[3], BONITA VAN HEEL[3], YOUNG HEO[3] and MICHAEL WESTON[3]

[1]Anthropology, Loyola University Chicago, [2]Environmental Dynamics, University of Arkansas, [3]Minnesota Dental Research Center for Biomaterials and Biomechanics, University of Minnesota

Dental microwear texture analysis revolutionized the field by providing more objective and repeatable data for reconstructing diet and behavior. However, little is known about the process of texture formation, including the effect of different foods and adherent abrasives. This study seeks to elucidate these issues by experimentally creating microwear textures using Artificial Resynthesis Technology (ART), a chewing simulator that accurately replicates the chewing cycle.

This pilot study used the latest version of ART, ART 5, on surgically extracted, occluding pairs of third molars (*n*=4). These pairs were subjected to 5000 chewing cycles using a controlled force between 50-250 N. Both the control and experimental groups used beef jerky, but the latter also included sand as an adherent abrasive. High-resolution molds were taken at 0, 50, 100, 2500, and 5000 cycles to record the progression of microwear textures. High-resolution casts were created and scanned for microwear textures using a white-light confocal profiler at 100X. These scans were uploaded into SFrax and Toothfrax software packages for texture characterization.

Results showed that beef jerky alone did not create microwear textures, even after 5000 chewing cycles. Only enamel prisms were recorded. However, when sand was introduced in the second experiment, microwear formation began by 2500 cycles, and was fully visible at 5000 cycles. This indicates that some foods, especially those that are soft, do not create microwear textures, but adherent abrasives can affect texture formation. This should be kept in mind when addressing issues surrounding hominin dietary strategies, especially those associated with meat eating.

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Spatial taphonomy and post-mortem disarticulation patterns of the *Homo naledi* assemblage from the Dinaledi Chamber, Rising Star Cave

ASHLEY KRUGER[1,2], PATRICK RANDOLPH-QUINNEY[3], MARINA ELLIOTT[1,2], JOHN HAWKS[4] and LEE R. BERGER[1,2]

[1]Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg South Africa, [2]School of Geosciences, University of the Witwatersrand, Johannesburg South Africa, [3]School of Forensic and Applied Sciences, University of Central Lancashire, Preston, United Kingdom, [4]Department of Anthropology, University of Wisconsin-Madison, Madison, United States

The Dinaledi Chamber of the Rising Star Cave has yielded over 1550 elements of *Homo naledi*. The extent of material recovered thus far has been limited to the surface of the chamber floor and the small excavation pit. The assemblage is commingled, and contains the remains of multiple adult and immature individuals. We adopt multiple lines of evidence from analyses of spatial distribution and bone clustering in an attempt to understand both the extent of fossil dispersal within the Chamber, as well as the processes by which fossils may have accumulated in the Dinaledi Chamber. A combination of registered white-light photogrammetry and high-resolution laser scans were used to collect three-dimensional data, providing an accurate location of each specimen. The spatial locations of 792 bone specimens from the Dinaledi Chamber were examined: 283 from the surface of the chamber floor, and 509 specimens from within the excavation unit sediments. Three main clusters of surface material were identified which show a concentration of fossils within the central region of the chamber, and a possible drop-off in fossil density in both adjacent passages and up-slope towards the chamber entrance in the direction of the Hill Antechamber. In the excavated deposits, we identified clusters by body part which are best attributed to the decomposition and disarticulation of the anatomical regions of multiple individuals in a confined space. A general downslope trend in the angular alignment of elements was noted within the Dinaledi Chamber itself, suggesting slight post-mortem movement of bones within their encapsulating matrix.

Questioning Oral Health: Dental Caries and Survivorship in Late/Final Jomon Period Hunter-Gatherers from Eastern Coastal Honshu, Japan

KAYLA KUBEHL and DANIEL TEMPLE

Anthropology, George Mason University

Bioarchaeological studies frequently evaluate "oral health" using dental caries prevalence. However, health is an integrated conceptualization of individual well-being and difficult to capture using lesion prevalence. This study explores the interaction between carious lesion presence/absence, lesion location, sex, and survivorship in a sample of Late/Final Jomon period (ca. 4300-2500 BP) hunter-fisher-gatherers from eastern coastal Honshu, Japan (n = 109). The goal is to explore the resonance of dental caries using survivorship as a measure of health. Carious lesions were recorded as present/absent on the crown or root of premolars and molars. Lesions extending from the crown to the root were also recorded. Carious lesion presence/absence, presence/absence by sex, location, and survivorship were explored using survival analysis. Survivorship was not associated with the presence/absence of carious teeth in the combined-sex sample ($p < 0.65$). Marginally insignificant differences in sex-specific lesion presence/absence were found ($p < 0.085$): males without lesions had lower survivorship than males with lesions ($p < 0.057$), while females with lesions had lower survivorship than females without lesions ($p < 0.075$). Individuals with carious lesion formation on tooth crowns had lower survivorship compared to individuals with carious lesions on tooth roots or extended onto tooth roots ($p < 0.02$); individuals without carious teeth did not differ from either group ($p < 0.382$; $p < 0.16$). Even within the context of a singular parameter of health, the relationship between dental caries and survivorship is complicated by factors such as lesion location and life history variables.

Enamel growth in Old World Monkeys

CHRISANDRA KUFELDT

Center for the Advanced Study of Human Paleobiology, George Washington University

Research on dental development in the apes and modern humans provides models of growth for fossil hominins, but very little is known about dental development in other primate clades. Investigating larger samples of primate taxa allows for a broader interpretation on the evolution of dental development and provides a comparative context in which to evaluate hominin dental evolution. This is the first study to describe enamel growth across a large sample of non-hominoid primates. I quantified enamel growth (daily secretion rate, enamel thickness, formation times, periodicity, and extension rate) in a sample of primates from the family Cercopithecidae to determine if dental development differs between the cercopithecini and papionini tribes, the frugivorous Cercopithecinae and folivorous Colobinae, and whether patterns of enamel growth are shared across catarrhines (Old World Monkeys and apes). Results show that Cercopithecidae have remarkably similar daily secretion rates and retain an ancestral pattern of enamel secretion across the crown compared with the great apes, which show a gradient in enamel secretion. The Colobinae have rapid formation times and thinner enamel, characteristic of folivorous species, relative to the omnivorous and frugivorous Cercopithecinae taxa. The papionini species show rapid enamel secretion and formation times despite larger body sizes suggesting that environmental factors may influence the rate of enamel growth. Overall, aspects of enamel growth appear derived in Old World Monkeys. Changes in growth and development, accompanied by a faster life history, may have been an adaptive strategy to outcompete the apes following the catarrhine divergence in the late Oligocene.

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The effect of food quality on vervet monkey (*Chlorocebus pygerythrus*) foraging decisions

TAMARA L. KUMPAN[1], JESSICA M. ROTHMAN[2], COLIN A. CHAPMAN[3] and JULIE A. TEICHROEB[1]

[1]Anthropology, University of Toronto Scarborough, [2]Anthropology, Hunter College of the City University of New York and New York Consortium in Evolutionary Primatology, [3]Anthropology, McGill University

Primates are known to make foraging decisions depending on such factors as competition, feeding patch size, and distance. However, the importance of key ingredients on food patch selection has as of yet been neglected. We ran a series of experiments on wild vervet monkeys (*Chlorocebus pygerythrus*) at Lake Nabugabo, Uganda to examine the influence of two rare nutrients on their foraging decisions. We used a multi-destination array consisting of five baited platforms in a large pentagon shape (5 m apart). Previous nutritional analyses had shown that the vervets diets were lacking in sodium and lipids, so platforms were baited with popcorn varying in these nutrients. Baseline trials (n=200) with plain popcorn and a beacon (orange flagging tape) were run to get the expected number of first visits to certain platforms, before testing trials (n=600) with one or two platforms containing popcorn of varying quality (salt only, oil only, salt and oil). Platforms with rare nutrients were indicated with a beacon. Binomial tests showed that relative to baseline expected values, platforms with rare nutrients were visited first significantly more than expected. Results were stronger for salt only platforms ($p<0.0001$) and salt and oil platforms ($p<0.0001$) than for platforms containing only oil ($p=0.01$). Thus, food quality can significantly alter the foraging decisions of vervet monkeys, with rare nutrients selected over sites without these nutrients.

Functional Morphology of the Monkey Hindfoot

SHARON KUO[1], BIREN A. PATEL[2,3], CALEY M. ORR[4,5] and CAROL V. WARD[1]

[1]Pathology and Anatomical Sciences, University of Missouri, [2]Department of Integrative Anatomical Sciences, University of Southern California, [3]Human and Evolutionary Biology Section, Department of Biological Sciences, University of Southern California, [4]Department of Cell and Developmental Biology, University of Colorado School of Medicine, [5]Department of Anthropology, University of Colorado Denver

Monkeys are known to traverse different types of substrates that vary in size and orientation. It has been hypothesized that tarsal joint morphology reflects how the foot and ankle need to move on these different substrates. Specifically, the astragalar trochlea should be more trapezoidal in shape and with a shallower groove in species that climb and walk on small diameter substrates as this might permit greater ankle plantarflexion. Similarly, a more obliquely oriented subastragalar joint would aid in ankle inversion, while greater range of inversion at the transverse tarsal joint should be facilitated by a broader navicular and more curved calcaneocuboid and astragalonavicular joints.

This study used geometric morphometrics on 3D landmark data from the calcaneus, astragalus, cuboid, and navicular of platyrrhines and cercopithecoids to test these proposed morpho-functional associations. Following a Procrustes fit of the landmarks, ANOVA of the principle component scores revealed differences among taxa in all four bones ($p<0.001$ for each) with results largely separating taxa along functional/behavioral lines. For example, the astragalar trochlea was more rectangular and less grooved in cercopithecoids than in platyrrhines, especially *Ateles* and *Sapajus*. The obliquity of the subastragalar articular surface was greatest in *Ateles*, but did not differ among the other taxa. The transverse tarsal joint surfaces were prominently curved in *Ateles*, and the navicular was broader, and cuboid peg projection was more pronounced in *Ateles* and *Colobus*. These results suggest that intertarsal joint motion as reflected in tarsal morphology correlate with different positional behaviors and substrates used by monkeys.

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Mandibular molar root morphology in *Homo naledi*

KORNELIUS KUPCZIK[1] and MATTHEW M. SKINNER[2,3,4]

[1]Max Planck Weizmann Center for Integrative Archaeology and Anthropology, Max Planck

Institute for Evolutionary Anthropology, [2]School of Anthropology and Conservation, University of Kent, [3]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [4]Evolutionary Studies Institute and Centre for Excellence in PaleoSciences, University of the Witwatersrand

Molar root morphology has been shown to inform on both taxonomic-phylogenetic relationships and dietary specialisations among middle to late Pleistocene fossil hominins from Europe. The dentition of *Homo naledi* from the Rising Star Cave system in South Africa has been described to have anterior root sizes comparable to that of Late *Homo* and australopiths, but overall smaller teeth than those of early *Homo*. Here we compare the root metrics (root length, root stem volume, radical volume and cervical plane area) of 13 mandibular M1, M2 and M3s belonging to six individuals from the Dinaledi Chamber to those of African and Eurasian Plio-Pleistocene fossil hominins derived from microCT-based reconstructions. Principal components analysis of the four root size variables shows a clustering of *H. naledi* that is distinct from all other taxonomic groups in all three molar positions. While the *H. naledi* molar roots are smaller than those of some *H. habilis*, *H. rudolfensis*, and *H. erectus*, they resemble those of two *Homo* sp. specimens from Swartkrans in size and overall appearance. Moreover, *H. naledi* molar roots are similar in size to later *Homo* but, unlike these, have relatively hypotaurodont roots with short root stems comparable to those of *A. africanus* and the robust australopiths. Consistent with previous studies showing that the Dinaledi dental assemblage is homogenous in molar crown size, the present findings support the notion that the *H. naledi* teeth belong to a single biological population showing affinities with other fossil *Homo* from South Africa.

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Location, Location, Location: Sexual dimorphism of the human pelvis has no universal pattern

HELEN K. KURKI[1] and CARA WALL-SCHEFFLER[2]

[1]Department of Anthropology, University of Victoria, [2]Department of Biology, Seattle Pacific University

Sexual dimorphism in the human pelvis presents an interesting contrast to other dimorphic aspects of the body. In most measures, such as body size, stature, organ size, and skeletal measures, males of a population are on average larger than females. In the pelvis, however, many bony measures, such as those of the obstetric canal, pubic bone length, and bi-acetabular breath, are absolutely larger in females than males, despite females' overall smaller body size. The size differences result in shape differences between both populations and sexes because the different sizes of each set of measures influences the overall geometry of the articulated pelvis. This is particularly true in comparing pelvic shape variation across populations of different overall body sizes. In a sample of 11 populations, females in small-bodied populations (N=4) show a positive relationship between medio-lateral (ML) and anteroposterior (AP) measures of the obstetric canal; this allows females to have the same overall size of the canal as larger-bodied populations, but not the same shape: in larger-bodied populations there is no positive relationship between ML and AP measures. In a multivariate analysis of bi-iliac breadth, bi-acetabular breadth, and the AP and ML breadths of the pelvic inlet, both population and sex have a significant influence on the model ($p<0.001$), and the interaction of sex and population are also significant ($p=0.007$), thus suggesting that pelvic sexual dimorphism does not show a single universal pattern.

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The effect of sub-zero environments on blunt-force trauma in bone

MARIE KVICALOVA and CAROLYN RANDO

Institute of Archaeology, UCL

The identification and differentiation of human-made trauma from naturally occurring changes to bone is becoming an integral part of forensic anthropology. Blunt-force trauma often causes fracturing, analysis of which can yield crucial information in legal cases. However, there is only a limited research into the impact of natural conditions like freezing on a traumatised bone. The volume expansion associated with freezing and freeze-thaw observed in other materials can have a significant effect on blunt-force trauma, potentially leading to alterations to the fracture patterns and general characteristics of the analysed area.

This experiment subjected 24 traumatised porcine radii to various scenarios of freezing and freeze-thaw ranging from eleven weeks of freezing in and out of water, flash thawing, flash freezing, and different cycles of freeze-thaw. The specimens were photographed prior to freezing, during, and after drying. These images were then used to score and compare qualitative and quantitative characteristics such as fracture length, colour, cortical flaking, and sharpness of fracture edges.

The results revealed that while there is change associated with sub-zero environments, especially correlated with an increasing number of freeze-thaw cycles, no alterations had a significant impact on the visibility of the trauma. Most notable qualitative and quantitative changes occurred during the initial cycles and the visibility of 52.3% of fractures declined. In conclusion, the results show that freezing temperatures are an important taphonomic agent, which affects the visibility and characteristic of blunt-force trauma, however, also point to the initial shock as a crucial trigger of change.

Examining the Osteological Paradox: Skeletal stress in mass graves versus civilians at the Greek colony of Himera (Sicily)

BRITNEY KYLE[1], LAURIE J. REITSEMA[2], PIER FRANCESCO FABBRI[3] and STEFANO VASSALLO[4]

[1]Department of Anthropology, University of Northern Colorado, [2]Department of Anthropology, University of Georgia, [3]Beni Culturali, Universita del Salento, [4]Regional Archaeological Superintendence, Palermo, Italy

Bioarchaeologists interpret skeletal stress as evidence of resilience or frailty, where absence of lesions might result from lack of exposure to pathogens (i.e., good health) or extreme vulnerability (i.e., selection). We examine physiological stress in two skeletal series from Greek Himera: (1) mass graves from the Battles of Himera (480 and 409BCE) and (2) Himeran civilians (648-409BCE). Civilians are assumed to have died from multiple causes, including ill health leading to their deaths. Individuals from the battles are assumed to have died prematurely; theoretically, soldiers would have had later ages-at-death had they not died in battle. We explore whether stress is associated with lower or higher morbidity and mortality (i.e., more prevalent among soldiers or among civilians, respectively), and compare skeletal stress within the battle and civilian samples. Cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia (LEH), and periostitis, were examined in 474 individuals (mass graves n=64; civilians n=410). Chi-square tests showed significantly higher prevalence of LEH ($p=0.037$) among male civilians than mass grave casualties. Variation in prevalence of skeletal pathology exists not only between, but also within the mass grave and civilian samples. Our findings generally support the hypothesis that skeletal stress is evidence of frailty (i.e., leading to greater risk of mortality). However, the relationship between stress and frailty is complicated by social factors, and considerations of historical context. We've identified nuances within our civilian and mass grave samples, including a possible soldier class that experienced less stress than the overall civilian population.

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Freezing for the Future: Costs, Culture, and Fertility Preservation Decisions in Trans Youth

MOIRA A. KYWELUK[1], AFIYA SAJWANI[2] and DIANE CHEN[2,3,4,5]

[1]Department of Anthropology, Northwestern University, [2]Division of Adolescent Medicine, Ann & Robert H. Lurie Children's Hospital of Chicago, [3]Department of Child & Adolescent Psychiatry, Ann & Robert H. Lurie Children's Hospital of Chicago, [4]Department of Psychiatry and Behavioral Sciences, Northwestern University Feinberg School of Medicine, [5]Department of Pediatrics, Northwestern University Feinberg School of Medicine

Increasing attention to the healthcare needs of transgender and non-binary individuals has resulted in younger patients beginning gender-affirming hormone treatment—that is, estrogen for birth-assigned males or testosterone for birth-assigned females. While access to treatment is still limited in the United States, youth initiating gender-affirming hormones may experience impairment in gonadal function leading to infertility or sterility. Increasingly refined, available, and deregulated gamete cryopreservation (egg/sperm "freezing") offers youth beginning hormone treatment the potential to preserve the possibility of future biological parenthood.

Transgender youth represent a new population for whom reproductive technologies may be beneficial, but the same realities of high initial and ongoing costs, and scant medical insurance coverage for gamete cryopreservation affect this patient population. As with many reproductive technologies, care options are framed and presented by providers as a healthcare choice, but the complexities and realities of access and affordability are at the forefront for patients. This paper explores ethnographic data drawn from the Trans Youth Fertility Study. Through a series of semi-structured interviews with transgender youth ages 14-24 from diverse socioeconomic and ethnic backgrounds, and separate interviews with their parents or guardians, this work explores how and when youth or parental desires for gamete cryopreservation are met by financial barriers, paying particular attention to the ways socioeconomic status, cultural and social identities inform medical decision-making processes and how these individuals interact with and understand technologies not originally designed for or made financially accessible to transgender patients.

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Stature and Sexual Dimorphism As Indicators of Non-Specific Stress Among the Peruvian Chiribaya

JESSICA R. LACERTE[1] and CARLY SLANK[2]

[1]Anthropology, University of Western Ontario, [2]Anthropology, Wayne State University

Stature and sexual dimorphism are cumulative indicators of growth outcomes and adaptation to general and specific stressors. Decreases in stature and sexual dimorphism may reflect increasing stress within a population over time due to intrinsic and extrinsic factors. Here, anatomical stature estimates for the Chiribaya (AD 900-1300) of coastal southern Peru are presented using the Revised Fully Method, with comparison to other pre-Columbian populations. Chiribaya stature was estimated by regressing lower long bone measurements against anatomical stature using 31 complete individuals (females= 11; males= 20). Sexual dimorphism (Xm-Xf/Xm) was estimated from humeral head diameter, femoral head diameter, and three talar dimensions; the reliability of these measurements for determining sex was estimated using logistic regression. Average statures of Chiribaya males (156 cm) and females (148 cm) are similar to those reported for other populations compared here. Of the three features examined, humeral head diameter displayed the most sexual dimorphism (11.5%), followed by talar dimensions (9.1%), and femoral head diameter (8.7%). On average, Chiribaya male classification was more reliable than female classification. Talar dimensions had the highest combined classification rate (83.7%), followed by humeral head diameter (82.6%), and femoral head diameter (82.6%). The Chiribaya occupied southern Peru during a period of political and environmental instability. Our results suggest that Chiribaya stature and sexual dimorphism were similar to other Andean populations, and reflect larger trends observed among agriculturalists throughout the pre-Columbian Americas.

Defining good health in the Paleolithic: Oral disease and a very distant patient

SARAH A. LACY

Department of Anthropology, California State University Dominguez Hills

Surveys of the prevalence of pathological conditions in Paleolithic humans are not routinely done, though partially this is because it is impossible to define a sufficient sample that would represent any viable population in the past. Individuals are too separated by space and time; however, this should not dissuade researchers from considering disease and pathology outside of case studies and in more comprehensive ways. As paleopathologists and bioarchaeologists now debate redefining terms and renaming phenomena related to growth disruptions, disease processes, and health such as at the recent Stressed Out conference in London, there are additional confounding factors for paleoanthropologists, such as not having access to large or contemporaneous samples and limited knowledge of diet and behavior relative to more recent samples. What can we say about "health" in the Paleolithic in this context, especially if health is being defined to include things like psychosocial well-being? We should as researchers working at the intersection of these disciplines more explicitly lay out the limits of potential conclusions on "health" in Paleolithic human remains to ensure our research avoids unsupported interpretations. Focusing on examples of oral disease indicators—because dental remains are more plentiful and the oral cavity is a microcosm of larger systemic "health"—these interpretative limits are proposed with the hope that others will challenge and remodel them. Though the Paleolithic patient is greatly removed from the researcher by time and culture, there are still some reasonable conclusions that can be drawn about how that individual experienced their health.

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The absence of secondary osteons in aged rats

SUSAN E. LAD

Anthropology, University of Florida

Secondary osteons form during bone remodeling – the process by which bone damage is repaired – yet not all animals have them. Previous reports (J Morph, 144:421-438; J Forensic Sci 51:1235-1239) show rat (*Rattus norvegicus*) femoral bone to be primarily non-vascular but they are inconsistent about whether rats have secondary osteons. The rats examined were young (3-6 months old), however, and secondary osteons tend to accumulate with age. Here, bone microstructure was examined in older rats to verify that these animals do exhibit signs of remodeling. Femoral midshaft and distal diaphysis thin sections of 11 male rats aged 24 months were examined. Contrary to younger rats, the aged rats have primary vascular bone with longitudinal canals, as well as non-vascular bone, in both midshaft and distal diaphyseal sections. The distal diaphysis also contains a large concentration of Volkmann's canals, especially toward the endosteal surface. No specimen contains secondary osteons. Previous assertions of secondary osteons in younger rats are likely misidentified primary osteons. It has been suggested (J Biomech, 36:1487-1496) that small bones have less extensive remodeling than larger ones, even though maximum strain can be equivalent in bones of different size. This may explain why small-bodied rats do not have secondary osteons. However, similarly sized marmosets do exhibit secondary osteons. Alternatively, the rat lifespan may be too short for remodeling to be

necessary given a limited timeframe of damage accumulation. Data from other small-bodied yet longer-lived rodents, such as the naked mole rat or guinea pig, would help test this hypothesis.

Use of *Euphorbia stenoclada* (Samata) as a fallback food in *Lemur catta* (ring-tailed lemurs) at Tsimanampesotse National Park, Madagascar

MARNI LAFLEUR[1], TARA A. CLARKE[2], NAYUTA YAMASHITA[3] and ANTHO I. JACKY[4]

[1]Anthropology, University of California San Diego, [2]Evolutionary Anthropology, Duke University, [3]Institute for Population Genetics, University of Veterinary Medicine Vienna, [4]Department of Biological Sciences, University of Toliara

Ring-tailed lemurs are hearty ecological generalists who are able to persist in a plethora of habitat types, and during times of prolonged food resource shortages, within south and southwestern Madagascar. During and following droughts, food resources can become extremely limited, and fallback foods (i.e. those whose use is significantly negatively correlated with the abundance of preferred foods) become key to surviving. Over several field seasons we examined the use of *E. stenoclada* by ring-tailed lemurs, a food that has not been previously reported for the species, and note that the food made up between 0-18.8% of the monthly diet. Additionally, we collected and later analyzed the nutritional properties of *E. stenoclada* during times when it was and was not consumed by the lemurs. Contents did not vary significantly between times when they were and were not consumed, however, we note that this resource is particularly high in lipids (≥14.8%) when compared to other lemur plant foods. Last, we noted the effects of heavy consumption of *E. stenoclada* on lemur hair loss and in relation to skin abrasions. This plant food is of particular importance to local people as it is used as fodder for domestic livestock. Reliance on *E. stenoclada* by local people and by ring-tailed lemurs makes this plant of particular anthropological significance.

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Dentine Without Borders: An improved dental macrowear scoring method with cross-cultural application

EMMA M. LAGAN[1], DANIEL E. EHRLICH[2] and SEAN M. PESCE[3]

[1]Anthropology, The Ohio State University, [2]Anatomy, Midwestern University, [3]Computer Science, SUNY Stony Brook

Analysis of dental wear allows anthropologists to study how individuals interact with their environment. These analyses can be conducted at both microscopic and macroscopic levels. The various uses of these techniques epitomize the tradeoff between speed and precision. Microwear analysis is very time intensive but provides the necessary precision to differentiate dietary groups. On the other hand, macrowear analysis is quick yet lacks precision, often providing purely descriptive data. Additionally, many traditional macrowear scoring methods focus on enamel loss and rely on wear patterns that were derived from one target population, making them ill-suited for broader applications. Building off a pilot study, we propose an improved method for scoring dental macrowear that measures dentine exposure in a way that allows for individual tooth variation and cross-cultural application. Furthermore, we present an intuitive, easy-to-use digital application that streamlines and standardizes data recording, reducing inter-observer error. We test this new method on anatomically modern human samples from 12th–16th century Europe (n=60) and 11th–14th century North America (n=30). Results indicate that the new method performs comparably to traditional methods, while offering greater precision. Although observations are qualitative, they approximate quantitative data and are therefore suited for more rigorous parametric testing, thus providing greater discriminatory power than traditional methods. While not a substitute for microwear methods, our new method takes a step closer by overcoming several limitations of traditional macrowear methods.

Paranthropus: A Pleistocene postcranial puzzle

MICHAEL R. LAGUE[1] and CAROL V. WARD[2]

[1]School of Natural Sciences & Mathematics, Stockton University, [2]Pathology & Anatomical Sciences, University of Missouri

Our knowledge of the *Paranthropus* postcranial skeleton has historically been limited by a scarcity of taxonomically unambiguous skeletons. Identification of isolated postcranial remains is further confounded by the presence of australopith-like features in non-*erectus* early *Homo*. Hence, taxonomic attributions based solely on an assumed postcranial dichotomy between *Paranthropus* (primitive) and *Homo* (derived) may be unfounded. Although several dozen postcranial specimens have been attributed to *P. robustus*, only a juvenile ulna (DNH 44) and the postcrania of the type skeleton (TM 1517) are associated with craniodental remains. In addition, although several sets of postcranial elements may be associated with *P. boisei* craniodental material, only the OH 80 skeleton offers reasonable certainty regarding both the association of specimens and their allocation to *Paranthropus*. Fortunately, comparative studies of humeri (an element common to OH 80, TM 1517, and other taxonomically secure skeletons) indicate that distal diaphyseal morphology is informative for identifying hominin species. Diaphyseal morphology supports claims regarding multiple postcranial 'morphs' at Swartkrans and has provided a basis for allocating specimens at both Swartkrans and Drimolen. In addition, multiple fossil humeri from Koobi Fora have been attributed to *P. boisei*, some of which are associated with additional postcranial elements (e.g., scapula, ulna, metacarpals, phalanges, femur, talus) that expand the foundation for testing taxonomic hypotheses. The recent addition of an upper limb skeleton (KNM-ER 47000) to the *P. boisei* hypodigm substantially augments our understanding of its postcranial anatomy and contributes to an emerging picture of a species with unique postcranial features and powerful forelimbs.

Quantifying energy costs in the primate feeding system

MYRA F. LAIRD[1], MICHAEL C. GRANATOSKY[1], CHRISTINE E. WALL[2], ANDREA B. TAYLOR[3] and CALLUM F. ROSS[1]

[1]Organismal Biology and Anatomy, University of Chicago, [2]Department of Evolutionary Anthropology, Duke University, [3]Department of Basic Sciences, Touro University College of Osteopathic Medicine

Performance differences between musculoskeletal systems are often estimated using energetic costs, implicitly or explicitly assuming that energy minimization is under strong selective pressures. For example, minimizing energy costs of locomotion is thought to be a driving force in the evolution of hominin bipedalism. Despite the potential importance of minimizing energetic costs in primate evolution, little is known about relationships between energy expenditure and musculoskeletal design in the primate feeding system. If minimizing energy costs is an important performance criterion influencing feeding-system morphology, we hypothesized that *Sapajus apella*, characterized by musculoskeletal features that facilitate hard-object feeding, would have lower mass-specific energy costs than *Macaca mulatta* when feeding on mechanically challenging foods. Energy differences are not expected between species when feeding on less mechanically challenging foods. We further hypothesized that these cost differences relate to muscle architectural dynamics, including smaller pinnation angles, higher gearing ratios, and greater mediolateral muscle thickness in *S.apella,* features minimizing energy costs.

We tested these hypotheses using respirometry and X-ray Reconstruction of Moving Morphology (XROMM) to measure feeding energy costs and muscle architecture dynamics in three capuchins and one macaque. Subjects were fed foods ranging in material properties (306.6-1709.7 Jm^{-2}; 0.07-19.42 MPa). Results show that *M.mulatta* expends only slightly higher amounts of energy when feeding on hard foods compared to *S.apella*

and this difference is associated with dynamic changes in muscle architecture. Our findings suggest that feeding-system performance may not reflect energy minimization and highlight the necessity of experimental research for testing similar hypotheses in primate functional morphology.

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Do the Dmanisi crania sample a single species?

EUNICE LALUNIO[1], ANDREW KRAMER[2] and ARTHUR C. DURBAND[1,3,4]

[1]Department of Sociology, Anthropology, and Social Work, Kansas State University, [2]Department of Anthropology, University of Tennessee, [3]Research Centre for Human Evolution, Griffith University, [4]Department of Anthropology, Science Centre, South Australian Museum

The five crania recovered from the Georgian site of Dmanisi represent the earliest hominin fossils to be found outside of Africa. The site provides a sampling of hominin variability during a critical time period, potentially illuminating the transition from earlier forms of *Homo* towards *Homo erectus*. While this variability is often interpreted as representing a single, dimorphic hominin population, some workers have suggested that more than one species may be present in the assemblage. Questions surrounding the depositional history at the site have contributed to this taxonomic uncertainty.

In this project we compare the range of variability in the Dmanisi crania to large samples of both modern human and ape crania using 16 Howells measurements. Coefficients of variation (CVs) were developed for every individual pairing between the Dmanisi crania and each pair within the comparative samples. These ape CVs were then compared to all pairings of the Dmanisi crania to see if the variability in the fossil sample matched or exceeded that expected for extant ape species. Statistical significance is generated for these comparisons.

The results suggest that the variability between the Dmanisi crania only rarely exceeds that expected within individual ape species or *Homo sapiens*. D2280 (Skull 1) is the cranium that is most often statistically significantly separated from other Dmanisi crania. This work supports interpretations of the Dmanisi crania as representing a single species, or even potentially a single population.

Funding for this project was provided by a Professional Development Award to AK from the University of Tennessee.

Patterns of Violence in Late Prehistoric and Protohistoric Populations of North Carolina and Virginia

PATRICIA M. LAMBERT

Anthropology Program, Utah State University

Several types of violent injuries are apparent in human skeletal remains from archaeological sites in the piedmont and mountain regions of North Carolina and Virginia. Recorded injuries include healed and lethal cranial vault fractures, embedded stone and lead projectiles, and scalping cut marks. As has been observed in a number of other archaeological samples from North America, healed cranial vault fractures are the most common type of injury, affecting about 10% of the total sample (6 mos.+). Projectile injuries are also present but less common (~2% affected), as are lethal cranial fractures (1.8% affected) and cases of scalping (1.3% affected). Spanning the years A.D. 800 – 1715, the skeletal assemblage provides a window into the social landscape of this eastern region during a period characterized by maize intensification, fortification, and ultimately, European contact. While levels of violence were lower here than in some contemporaneous small-scale societies of the Eastern Woodlands (e.g., Koger's Island, northern Alabama; Norris Farms, west-central Illinois), these patterns of injury, in conjunction with evidence for palisades at most settlements, suggest that both intra- and intergroup conflict were ongoing concerns for the farming peoples of this region throughout the late prehistoric period and well into the early years of European contact.

This research was funded in part by a grant from National NAGPRA to the Research Labs of Archaeology at UNC-Chapel Hill.

Craniofacial asymmetry and the presence of a unilateral bifid mandibular condyle from an identified skeletal collection

KATHERINE M. LANE and FRANK L. WILLIAMS

Anthropology, Georgia State University

Macroscopic and radiographic observations are reported on a unilateral bifid mandibular condyle with associated craniofacial asymmetry found on a nearly edentulous individual of known age and sex from the William M. Bass Donated Skeletal Collection of the Forensic Anthropology Center at the University of Tennessee, Knoxville. The right mandibular condyle exhibits an anteroposterior groove separating a larger medial articulation from a smaller, semi-atrophied lateral head. The medial articular surface is more radiopaque than the lateral counterpart indicative of greater mineralization. This medial articulation may have borne the majority of masticatory loads from the combined action of the masseter and temporalis muscles. The unaffected left condyle is more radiolucent than the antimere suggesting greater loading on the right. Compared to the left side, the affected right ascending ramus is superoinferiorly short, anteroposteriorly narrow and deflected laterally. Visible asymmetry in the glenoid fossae of the temporal bones exists such that the left unaffected articular surface is more deeply excavated, coupled with a more prominent articular eminence compared to the right. Gonial eversion is visible only on the right corpus-ramus angle, and the temporal lines are more marked on the right than on the left parietal squama. We suggest that the unilateral bifid mandibular condyle arose from congenital factors rather than craniofacial trauma. The resulting asymmetry of the masticatory complex from the uneven loading and constricted articulation of the right side led to a series of muscular changes that had a marked impact on the facial skeleton.

Scaling patterns of primate paraflocculi: effects of phylogeny and ecology

MADLEN M. LANG, ORNELLA C. BERTRAND and MARY T. SILCOX

Department of Anthropology, University of Toronto Scarborough

The paraflocculi are lobes of the cerebellum which regulate several functions associated with vision including smooth pursuit and velocity control of eye movements, and the stabilization of visual images on the retina. In some primates these structures fill a distinct cavity in the petrosal bone (subarcuate fossa). Due to their functional significance and the ability to isolate them in endocasts, studying the relative size of the paraflocculi may provide ecological information for fossil taxa. Analysis into the scaling patterns of rodent paraflocculi suggest that they scale according to ecological factors such as activity pattern and locomotor type. No such analysis has been performed for primates.

Here, paraflocular and total endocranial volumes were calculated from microCT scans for more than 25 extant primates including strepsirrhines, New World monkeys, and tarsiers, and these data were examined to determine if ecological factors play a role in the volume of the paraflocculi. Relative paraflocular volume was examined in a regression analysis according to three categories: Suborder, Activity Pattern, and Diet. Based on these analyses, it appears that phylogeny plays a central role in the scaling of the paraflocculi, as strepsirrhines consistently have relatively larger paraflocculi than haplorrhines, which may be related to neocortical expansion in the latter group. Although there is no clear signal for activity period, frugivores generally exhibit relatively larger paraflocculi than omnivores. These results suggest that there may be some ecological

relevance to the size of the paraflocculi, but that phylogeny must be taken into consideration.

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Embodied discrimination and "mutilated historicity": Archiving black women's bodies

AJA M. LANS

Anthropology, Syracuse University

Recent research has introduced a structural violence framework to bioarchaeological investigations. Such work integrates paleopathological analyses and treatments of the body, including postmortem interventions such as dissection, to reflect upon the embodiment of inequality. Here, I draw on this framework to consider the extended life course of black women's bodies, as evidenced by bones and texts in the George S. Huntington Anatomical Collection. This Collection includes the remains of 3600 New York City residents and European immigrants who died in the city between 1893 and 1921. Their bodies were subsequently dissected at the College of Physicians and Surgeons, and the bones archived as a comparative collection. My research focuses on the 82 women cataloged as "black" or "negro" upon death. Most of these women worked as domestics, lived in segregated neighborhoods, and died in almshouses and public hospitals. Over half died of tuberculosis, a disease that often serves as a prime example of the effects of structural violence. This affliction, along with dissection and curation, reflect multiple forms of structural violence that marked these women's bodies. Here, however, I want to expand upon these skeletal indicators by merging the skeletal archive with its associated texts and consider the "mutilated historicity" of black women's archival records along with their physical bodies.

Isotopic analyses of fossil hippopotamid enamel as a proxy for aquatic-terrestrial interface environments in the Pliocene Rift Valley, Baringo Basin, Kenya

STEPHANIE S. LAPEYRE-MONTROSE and JOHN D. KINGSTON

Anthropology, University of Michigan

Fossil sediments 3.5-2 Ma in Equatorial Africa document early hominin taxonomic and behavioral diversification, including the origin of robust australopiths, genus *Homo*, and the earliest evidence of lithic artifact manufacture. Ongoing research seeks to develop a refined paleoecological context of hominin evolution by utilizing stable isotopic analyses of associated fauna. This study utilizes isotopic analyses of fossil hippopotamid enamel to identify shifts in dietary and water resources in the Tugen Hills Succession corresponding to a core extracted from the Chemeron Formation as part of the Hominin Sites Paleolake Drilling Project (3.5-2.6 Ma). Hippopotamids are unique in potentially transcending the aquatic/terrestrial interface, providing an opportunity to characterize the shifting and variable nature of axial rift valley environments. Although modern hippopotamids are primarily characterized as semi-aquatic, nocturnal C_4 grazers, $\delta^{13}C_{enamel}$ values of -13.7‰ to +4.1‰ for modern hippopotamids, and -12‰ to 2.5‰ for fossil taxa, indicate highly variable foraging strategies. Isotopic analyses of fossil hippopotamid enamel collected from the Chemeron Formation targeted a series of regression/transgression events 4-2 Ma. Fossil Baringo hippopotamid cumulative $\delta^{13}C_{enamel}$ values range from -12.9‰ to 1.8‰, with more positive values tentatively linked to lake regressive phases. $\delta^{18}O_{enamel}$ values vary from -9.1‰ to 0.6‰, a range greater than all other fossil sites combined (-6.1‰ and -0.9‰) and similar to all modern hippos analyzed (-6.17‰ to 4.2‰). Chemeron isotopic values suggest frequent and/or long duration of dry seasons in the Baringo Basin during this time, indicating highly variable environmental conditions with implications for interpreting this key phase of hominin evolution.

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Reconstructing the life of a wild gorilla based on pathological features in the skeleton: Implications for the bioarchaeology of care

ALEJANDRO LASERNA[1] and KATE PECHENKINA[1,2]

[1]Anthropology, Queens College City University of New York, [2]New York Consortium in Evolutionary Primatology

Humans are capable of surviving debilitating traumas and life-threatening injuries primarily because of provision and care afforded by social support networks. We expect post-trauma survival to be diminished in non-human primates because of the lack of community support. Here we present a case of a *Gorilla g. gorilla* found in Cameroon, surviving multiple debilitating injuries and enduring to approximatey 35 years old (43 being the maximum recorded lifespan in the wild). The adult male skeleton bears evidence of numerous healed fractures on the left portion of its body, including rib, metacarpal, and metatarsal fractures. Compression fractures of vertebral bodies of T11 & T12 as well as a severe compression fracture of T7, likely lead to an angular deformation of the spine. There is severe eburnation and erosion on the femoro-tibial articular surface, suggesting advanced osteoarthritis of the knee. Combined with osteophytes present on the acetabulum and patellae, these pathological changes indicate limited and painful mobility. Severe occlusal wear lead to traumatic pulp exposure on multiple molars, canines, and incisors. There is evidence of severe degenerative joint disease of the temporomandibular joint, likely impairing the lateral excursion of the jaw. The ability of this male gorilla to survive multiple injuries, despite the lack of human-like care, has important implications for the bioarchaeology of care and our interpretations of injury survival in early human species.

More than meets the eye: what chemical analyses can reveal about hair color

TINA LASISI[1], SHOSUKE ITO[2], KAZUMASA WAKAMATSU[2], MARK D. SHRIVER[1] and NINA G. JABLONSKI[1]

[1]Department of Anthropology, Pennsylvania State University, [2]Department of Chemistry, Fujita Health University, School of Health Sciences

Research on human hair pigmentation has relied primarily on subjective qualitative descriptions, such as 'black' or 'brown', rather than objective quantitative methods. Although verbal descriptions have facilitated the identification of genetic loci associated with variation in European populations, the categories of hair color used describe most non-European populations as 'uniformly dark-haired'. Previous research has detected some variation among dark-haired populations using narrow-band reflectance spectrophotometry, suggesting that different methods may reveal more fine-scale variation. Here, using chemical methods to assess the absorbance of melanin and specific degradation products of eumelanin and pheomelanin, we demonstrate an appreciable level of variation within perceived hair color categories among human metapopulations. Samples of African hair categorized as 'black' have more eumelanin degradation products and higher spectrophotometric absorbance than Asian and European 'black' hair. Variation within and across these hair color categories suggests that a lot of information may be lost by relying solely on perceived hair color. These chemical methods may represent a way of capturing salient, but imperceptible, phenotypic variation that is relevant to the genetic architecture of human hair pigmentation. Moreover, understanding variation quantitatively is essential for exploring the extent to which genetic drift and selection pressures have acted on these traits. The feasibility of applying these methods, or variants thereof, on a larger scale by future genetic association studies is discussed, and chemical methods are compared with insights from microscopical methods and full spectrum reflectance spectrophotometry.

From harvest to hunger: How mothers feed babies across seasons in Malawi

RYAN LATULIPE[1], TIFFANY MARK[1], MARTINA ANTO-OCRAH[2], DAVID H. ADLER[2] and JOSEPH W. LANNING[3]

[1]School of Medicine & Dentistry, University of Rochester, [2]Department of Emergency Medicine, University of Rochester, [3]Department of Anthropology, University of Georgia

Exclusive breastfeeding is well documented to reduce morbidity and mortality for children under the age of six months, yet rates continue to be low in both the developed and developing world. In Malawi, only 4-7% of infants under six months are exclusively breast fed. We collect and interpret ethnographic data about mothers' decisions to supplement infant diets prior to age six months. We conducted a quantitative and qualitative study of breastfeeding practices in the Ntcheu District of Malawi between October 2016 and June 2017. Mothers with four and five month old babies were recruited at Under 5 Clinics administered by the Gowa Health Center. Surveys at mothers' homes included demographic information, birthing history, and a 24-hour dietary recall. Qualitative data collection focused on the decision-making process regarding commencing supplemental feeding. 84.4% of 178 mothers interviewed were familiar with the benefits of exclusively breastfeeding their child until the age of six months, but only 16 mothers (8.9%) exclusively breastfed their children in this age group. 62% of 175 mothers stated they introduced supplemental foods because their child was "crying", "causing trouble", or had "stomach aches". Eighty-two mothers (63.4%) counted their child's age in a way that overinflated the child's actual age. In addition to presenting the normative weaning trajectories, we show evidence that lack of knowledge is not responsible for low rates of exclusive breastfeeding in rural Malawi. Rather, mothers believe their children are older than they are, subsequently resulting in introductions of supplemental foods prior to six months.

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Intra- and interspecific endocranial volume variations in the family Hylobatidae

EMILY LAU[1], ROBERT D. MARTIN[2] and LU YAO[3]

[1]Anthropology and Biochemistry, Hunter College, The City University of New York, [2]Integrative Research Center, The Field Museum of Natural History, Chicago, [3]Mammalogy, The American Museum of Natural History, New York

Hylobatidae is a family of speciose small bodied-apes habituating both mainland and islands in Southeast Asia. Hylobatids consist of four genera: *Hylobates*, *Hoolock*, *Nomascus*, and *Symphalangus*. Hylobatids underwent adaptive radiation beginning in the early Miocene and rapidly diversified during the Plio-Pleistocene glaciation period as sea level changes affected geographic barriers and sympatric zones. Studies of the brain across a range of primate taxa reveal that gibbons have a relative neocortex volume similar to that of apes and greater than monkeys except capuchins. Measurements also show that gibbons have a small relative frontal lobe volume amongst apes, but it is comparable to those of monkeys. However, these neuroanatomical studies have not sampled from a broad range of gibbon species. In this study, we use gibbon specimens housed in museum collections to examine intra- and interspecific endocranial volume variation. Linear and volumetric measurements from museum specimens of thirteen Hylobatidae species (N= 437) were used to compare absolute and relative brain size across this family of apes. Allometric scaling analyses reveal that *Nomascus* species have the greatest relative brain size, with an absolute endocranial capacity similar to that of the large-bodied siamangs but body sizes similar to those of small-bodied *Hoolock* and *Hylobates* gibbons. *Nomascus* species had the lowest variation in body size while *Nomascus concolor* had the greatest variation in brain size across all hylobatid taxa. This thorough analysis of brain size across gibbons and siamangs will further our knowledge about the evolution of brain size across primates as a whole.

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Re-examining birth constraints in non-human primates

NATALIE M. LAUDICINA[1] and MATT CARTMILL[1,2]

[1]Anthropology, Boston University, [2]Evolutionary Anthropology, Duke University

In the past, birth mechanics in different primates have been compared with reference to birth-canal planes (inlet, midplane, outlet) defined by markers of human obstetric constraint. These comparisons have supported the consensus that birth is more difficult in humans than in non-human primates. However, the adaptations of the human pelvis to bipedality create unique bony protuberances into the birth canal, not seen among non-humans. Conventional human obstetric planes, defined in terms of the human protuberances, may not accurately reflect areas of constraint among non-human primates. In this research, we investigated whether other parts of the pelvis impinge on the birth canal in non-human primates and have the potential to slow or obstruct the movement of the fetus during parturition.

Female anthropoid primate pelves (n=37, seven genera) were scanned at the Harvard Museum of Comparative Zoology and birth canals were reconstructed using AutoDesk® Maya® 3D animation software. Species-specific areas of bony impingement on the birth canal, not seen in humans, were identified. These potential obstetric constraints have gone unrecognized in the past because they do not lie in planes defined by the human anatomical markers.

Human birth may still be more difficult than that of other primates, but that inference cannot safely be drawn from comparisons limited to human obstetrical landmarks. This research demonstrates a need for species-specific analyses in describing and comparing birth mechanisms and points of potential dystocia in living and fossil hominins and other primates.

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Estimating the *in vivo* location of the talar head using surface markers

STEVEN G. LAUTZENHEISER[1,2], MIGUEL OCHOA[1] and PATRICIA A. KRAMER[1,2]

[1]Anthropology, University of Washington, [2]Department of Orthopaedics and Sports Medicine, University of Washington

Finite element analysis (FEA) has gained popularity when attempting to connect morphological form to measurable function. A critical component of FEA is ensuring that loads are applied in locations that make both functional and anatomical sense. In the foot, one such location is the center of the talar head, where the ground reaction forces of toe-off must be transferred from the midfoot. The location of the talar head cannot, however, be palpated; its location can only be directly determined via invasive scanning. Thus, we propose a regression-based method to locate the *in vivo* position of the center of the talar head by employing 3-dimentional surface markers.

Simulated weight-bearing computed tomography (SWCT) scans of 15 randomly selected people from the database of a Level 1 trauma center were used for this study. The 3-dimentional location of each metatarsal head; the dorsal navicular; the navicular tuberosity; the styloid process on the fifth metatarsal; the lateral surface of the calcaneus; the lateral and medial malleoli; the lateral and medial calcaneal tuberosity; and the center of the talar head was measured on each SWCT.

Linear regression was used to determine the ability of each location to predict the position of the center of the talar head. All markers were predictive (all p's < 0.001); the dorsal navicular marker predicted 99% of the variability (r^2= 0.99). This study demonstrates that external markers can be used to predict the location of the center of the talar head.

The Evolution of Femoroacetabular Impingement

AUSTIN B. LAWRENCE[1,2] and PAUL A. SANDBERG[3]

[1]Department of Anthropology, University of Colorado Boulder, [2]Department of Pathology and Anatomical Sciences, University of Missouri, Columbia, [3]Archaeology Division, Sam Noble Oklahoma Museum of Natural History, University of Oklahoma

Femoroacetabular impingement (FAI) is a clinical pathology of the hip resulting from repeated abutment of an abnormally shaped femoral

head-neck junction with the acetabular rim. One form of FAI, the cam-type deformity, is thought to result from mechanical stress on the femoral head-neck junction during epiphyseal fusion and from intense, repeated loading of the anterior aspect of the hip. Recently, debate has emerged surrounding whether FAI is a modern phenomenon or if it affected people in antiquity. A recently published study revealed an isolated case of FAI from the late Neolithic of Switzerland; however, it is still unclear whether FAI was common in populations at this time. Here, we present a re-evaluation of evidence from the Early Christian Period site of Kulubnarti, Nubia (modern Sudan; 550-800 CE), to determine how prevalent FAI-like morphology was in this medieval population. We photographed the femora of 128 adult individuals from Kulubnarti and quantitatively assessed them for morphology consistent with cam-type FAI by measuring the alpha angle of the femur. Results suggest that as much as 30% of the population from Kulubnarti had morphology consistent with FAI, more than double the proportion estimated to have this morphology in modern populations. We present an argument that the morphology now associated with FAI may have emerged deep in human history, possibly as a response to the increased load-bearing responsibilities of the hip in hominin bipedalism.

Alveolar-arch morphology and species diversity in early *Homo*

JULIE LAWRENCE[1] and WILLIAM H. KIMBEL[1,2]

[1]Institute of Human Origins, Arizona State University, [2]School of Human Evolution and Social Change, Arizona State University

Early representatives of the *Homo* lineage (e.g., LD 350-1, KNM-ER 60000) have begun to fill an enduring gap in the fossil record regarding the origin of our genus. These fossils retain alveolar-arch shape information, a long-standing diagnostic feature in hominin systematics, allowing us to assess the morphological distance between australopiths and these early *Homo* specimens, and to ask if the variation within early *Homo* is comparable to, or greater than, that observed within australopith species. We used geometric morphometric methods and linear analysis to investigate shape variation and covariation within the mandibular alveolar arcade of *Australopithecus* (N=20), *Paranthropus* (N=10), and early *Homo* (N=9), as well as in a comparative sample comprising gorillas (N=21), chimpanzees (N=30), and modern humans (N=52). We recorded 14 homologous landmarks along the alveolar arch between the canine and the third molar on each specimen. Results indicate that, despite encapsulating several species, the early *Homo* sample shows relatively low size variance, as well as shape variance comparable to that observed within individual australopith species (particularly *Au. afarensis*). We demonstrate that overall size, and covariation between the canine and postcanine regions, cannot explain the majority of shape variation in the alveolar arch, and show how subtle differences across the arch produce distinct taxon-specific mean shapes, similar levels of within-taxon variance, and overlaps in the major axes of variation. These results are discussed in light of suggestions that early *Homo* species can be reliably distinguished by their alveolar arch shape.

Location, Location, Location: Interpreting Skeletal Fractures and Mortuary Practices in a Spatial Perspective

VALERIE A. LEAH

School of Human Evolution and Social Change, Arizona State University

A sample of well-preserved adult human skeletal remains (n = 218) from two medieval Nubian cemeteries at Mis Island was analyzed to investigate the patterns and prevalence of skeletal fractures in the Fourth Cataract region. These trauma data were further evaluated based on patterns of interment in cemeteries 3-J-10 and 3-J-11 using four (geo)statistical tests. This novel approach is the first to critically interpret intra-site relationships between skeletal trauma and mortuary practices. The research goals are: to determine if the presence of skeletal trauma influences interment location; to evaluate if the spatial patterning is significant; and to investigate if the analyses can be used to predict attributes (i.e., sex, age, trauma) of unexcavated individuals.

Preliminary results indicate the patterns present in the universal kriging maps for cemetery 3-J-10 are not statistically different from random. This is apparent for presence of skeletal trauma (z = -0.44; p = 0.66) and for the first principal coordinate, age/sex cohort affiliation (z = -0.21; p = 0.83). Results for cemetery 3-J-11, however, are intriguing. Spatial distributions of trauma (z = 2.88; p = 0.004) and the first principal coordinate (z = 2.24; p = 0.025) are significantly different from random. Overall, individuals with skeletal trauma tend to be middle adult males buried in the western periphery of the burial space. Additionally, the kriging models are good fits for the dataset but are unsuitable predictors. Findings suggest this interdisciplinary approach may provide interesting insights into mortuary practices at other bioarchaeological sites as well.

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In silico modeling of glenohumeral joint variation in biomechanical function and stability

ERIN C.S. LEE[1], ALLISON CLOUTHIER[1], RYAN BICKNELL[1], MICHAEL J. BEY[3], NEIL T. ROACH[2], NATHAN M. YOUNG[4] and MICHAEL J. RAINBOW[1]

[1]Mechanical & Materials Engineering, Queen's University, [2]Human Evolutionary Biology, Harvard University, [3]Bone & Joint Center, Henry Ford Hospital, [4]Orthopaedic Surgery, University of California San Francisco

During human evolution, scapular morphology has shifted from a cranial to a more laterally-facing glenoid, presumably facilitating a shift in activities from climbing and hanging to throwing and digging. We utilized three-dimensional bone surface data and kinematics acquired from biplanar videoradiography to build a muscle fiber elongation model and estimate the relationship between cranial orientation of the glenoid and biomechanical function in humans. We hypothesized that at low ranges of abduction (below the head), the lines of action of the muscle fibers would move from perpendicular to the glenoid surface to parallel and the moment arms would decrease as cranial orientation increased. This prediction was based on the reasoning that the joint optimally functions when opposing muscles act to increase the contact force vector, which increases congruence, without supplying a tangent dislocating force. Our results indicate that the cranial orientation of the glenoid substantially alters the lines of action of inferiorly directed muscles. We find that in individuals with more cranially oriented glenoid, the teres major, teres minor, and infraspinatus have less ability to translate the humerus inferiorly. This may increase the risk of rotator cuff dysfunction by compromising the ability of these muscles to maintain a stable shoulder. However, it also remains possible that this reduced translation ability in cranially oriented glenoids acts instead to prevent excessive translation, yielding a more stable joint. Further modeling study of glenohumeral joint dynamics is required to parse these alternatives.

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Lifestyle factors influencing frame size, grip strength, and bone density in two related populations

KATHARINE M.N. LEE[1], MARY P. ROGERS[1], ANDRZEJ GALBARCZYK[2], GRAZYNA JASIENSKA[2], JOHN D. POLK[1] and KATHRYN B.H. CLANCY[1,3]

[1]Department of Anthropology, University of Illinois at Urbana-Champaign, [2]Institute of Public Heath, Jagiellonian University, [3]Beckman Institute of Advanced Science and Technology, University of Illinois at Urbana-Champaign

Western, educated, industrialized, rich, democratic (WEIRD) populations dominate bone health research. Osteoporosis risk is associated with race and frame size in the U.S., with White women having lower bone density and higher rates of osteoporosis than Black women. U.S. White women also have higher rates of osteoporosis than women in several Eastern European countries, including Poland. This suggests that osteoporosis risk is not due to biological

"Whiteness" but other lifestyle factors affecting bone.

We investigated differences in frame size and bone density in two related populations of adult premenopausal women (age 18-46) from two environments (n=46 Polish women from rural Mogielica Human Ecology Study Site; n=39 Polish-American women). We collected life history data, standard anthropometric measurements, grip strength, and bone density in the radius.

Polish women had higher grip strength and wrist width than Polish-American women, and Polish women who farmed during childhood had higher grip strength than Polish women who did not farm (T-test, p=0.005 ,0.002,0.04). Grip strength in Polish women is associated with wrist width, elbow width, bicep circumference, and lean mass (univariate linear models, adjusted R^2=0.39, 0.19, 0.27, 0.4; p=<0.001, 0.001, <0.001, <0.001). Grip strength in Polish-American women only shows weak associations between bicep circumference and lean mass (adjusted R^2=0.09, 0.03; p=0.03, 0.03). Bone density is higher in Polish than Polish-American women.

Our results show structural effects of life experience and childhood environment on bone. Furthermore, our results suggest bone health outcomes commonly attributed to race in WEIRD populations should be examined considering systematic differences in lived experience.

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Can a skull tell us the facial shape?: prediction of facial components based on craniometric analysis

WON-JOON LEE[1], U-YOUNG LEE[2], SANG-SEOB LEE[3], BYUNG-YOON ROH[3], JEONG-UK SEO[3], CHANG-UN CHOI[1], KI-SU PARK[1], JI-SU YUN[1] and SOO-MIN KIM[1]

[1]Department of Forensic Medicine Investigation, National Forensic Service Seoul Institute, [2]Catholic Institute for Applied Anatomy, Department of Anatomy, College of Medicine, Catholic University of Korea, [3]Medical Examiner's Office, National Forensic Service

Forensic craniofacial reconstruction (CFR) is a technique to rebuild a face onto a skull to recreate the ante-mortem appearance of the individual. The ultimate aim of CFR is to recreate an *in vivo* countenance of an individual that sufficiently resembles the decedent in order to allow recognition and then identification of the individual. Therefore, how to accurately predict the face is the most important part of CFR. The accuracy of CFR depends fundamentally on how accurately the facial components such as eyes, nose, and mouth can be predicted through the morphological and craniometrical analysis of the skull. Until present, practitioners in CFR have used the results studied by a number of relevant researchers. However, these methods are outdated, or have a lack of objective grounds. Moreover, most of the studies have mainly focused on white European subjects. Thus there are still many uncertainties about applying the prediction methods to Asian CFR. In order to resolve the problem, researchers in Korea have studied facial components prediction methods employing Korean subjects. A current performing study is about the shape and location of eyebrows and nostrils, which significantly influence the impression of the face. The study has been carried out utilizing cranio and anthropometric analyses between the skull and corresponding facial regions. In this presentation, we will present an overview of the facial components prediction methods currently used by CFR practitioners, and to introduce the results of facial components prediction methods obtained from the current research.

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Three-dimensional skull and face models: the measurements based on the landmark coordinates

U-YOUNG LEE and DONG-HO KIM.

Department of Anatomy / Catholic Institute for Applied Anatomy, College of Medicine, The Catholic University of Korea

The three-dimensional model has several advantages for morphological study in the preservation of samples, transfer of data, and continuous usage of landmarks and metric data, although it is reasonable that real object is the best sample. Catholic Institute for Applied Anatomy had collected the computed tomographic (CT) images of 732 Koreans stored in Seoul St. Mary Hospital and then reconstructed 681 3D models of cranium, mandible and face from acquired CT images using Mimics program (version 14.0, Materialise, Belgium) excluding 51 samples due to transformation of skull and face. The sample size is 337 in male and 344 in female. Each age group has at least 30 samples.

To investigate anthropological measurements and facial thickness in 3D space, 90 landmarks on the cranium, 62 landmarks on mandible and 134 landmarks on the face were used according to the definition of each landmark. The accuracy of location data of landmark is important because the measurements are calculated automatically from each landmark. To minimize the error by observers' experience and knowledge on the definition of each landmark, the process of landmarks on the 3D model was marking a point using standard or guide planes. To verify the modified process of landmarks, the intraclass correlation coefficient (ICC) between 4 observers was investigated, and about 99% of total measurements showed high ICC.

The database of the 3D head model is expected to be used as the basic reference materials of Korean for forensic anthropological researchers.

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Isotopic dietary variability distinguishes East African *Paranthropus boisei* from South African *P. robustus*

JULIA A. LEE-THORP and SCOTT BLUMENTHAL

Research Laboratory for Archaeology, School of Archaeology, Oxford University

The two roughly coeval robust australopith taxa, *Paranthropus boisei* and *P. robustus*, share a suite of features including a dished, buttressed face, prominent muscle attachments, post-canine megadonty, reduced anterior teeth, and thick enamel, which together point to diets that require heavy, forceful oral processing. Despite these anatomical similarities, however, the carbon isotopic evidence suggests marked dietary differences in two important ways. Firstly these data indicate that *P. robustus* (mean $\delta^{13}C$ = -7.4‰, SD = 1.3‰, n = 22) leaned towards C_3 foods, while *P. boisei* (mean $\delta^{13}C$ = -1.2‰, SD = 1.1‰, n = 26) relied almost exclusively, and unusually for a primate, on C_4 foods. A further distinction lies in their dietary versatility. The range of variability amongst *P. robustus* individuals($\delta^{13}C$ -10.0 to -4.9 ‰) is higher than amongst *P. boisei* individuals (-3.4‰ to 0.9‰). High-resolution laser ablation analysis of *P. robustus* tooth crowns demonstrates significant intra-tooth isotopic variability (up to 5.2‰) associated with periodic shifts from a primarily C_3 diet to feeding on greater than 50% C_4 resources. We do not yet have similar data for *P. boisei,* but we can infer that its diet was more specialised and restricted largely to C_4 resources year-round as suggested by mean values near 0‰ and isotopic similarity of different teeth of the same individual (within ~2‰, n=2). This lack of isotopic variability suggests to us that *P. boisei* was ecologically and adaptively distinct from the South African form.

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Early hominin environments in southern Africa: A micromammalian perspective

JENNIFER N. LEICHLITER[1], OLIVER C.C. PAINE[1], NICO L. AVENANT[2] and MATT SPONHEIMER[1]

[1]Department of Anthropology, University of Colorado Boulder, [2]Department of Mammalogy, Bloemfontein National Museum

The Plio-Pleistocene (~3-1 Ma) saw the decline of the genus *Australopithecus*, the rise of

cranio-dentally robust *Paranthropus*, and the emergence of the genus *Homo*. In South Africa, faunal analyses indicate that a marked shift from forest, to more open, savanna/grassland habitats took place during this period. Much of this research has focused on large- to medium-bodied mammals (such as bovids) and excludes small taxa, despite their abundance in South African fossil deposits. However, one previous study found little evidence of change in micromammal community composition between deposits of different ages and argued that conditions were more arid in the past than are characteristic today. These findings differ from interpretations made based upon larger fauna. It therefore remains unclear how to integrate these two lines of evidence. In this study, we use data from both previously published research and newly identified material to revisit the micromammalian fossil record in southern Africa. We employ taxonomic habitat indices, diversity indices, and stable isotope analyses to assess the environmental context of several hominin-bearing sites in the Cradle of Humankind. These methods allow for direct comparison of our data to both the large mammal fossil record and to similar studies of micromammals in eastern Africa. Our analyses suggest that, unlike large mammals, micromammalian communities do not evidence a clear shift to open, savanna/grassland adapted taxa during this time period. Instead, they indicate the presence of specific microhabitat elements, such as waterways and dense grassy cover.

This research was funded by the National Science Foundation (NSF, USA) and is a product in whole or in part, of the Nutritional and Isotopic Ecology Lab at CU Boulder.

New insights into the morphological relationship between bony labyrinth and cranial base in modern humans

ANNE LE MAITRE

Department of Theoretical Biology, University of Vienna

The petrous bone houses the labyrinth, the organ of balance. Efficient detection of head rotation imposes strong constraints on the shape and orientation of the three semicircular canals. Across primates, labyrinth morphology correlates with the orientation of the petrous bone in the cranial base. Also throughout human fetal development, labyrinth and cranial base morphology change jointly. However, little is known about how this ontogenetic process relates to the phylogenetic association.

Here, I present the first three-dimensional geometric morphometric study on the intraspecific morphological relationship between the bony labyrinth and the basicranium. In a sample of adult modern humans, the association between the shape coordinates of two sets of 22 landmark (bony labyrinth *vs.* cranial base) was investigated using partial least squares analyses.

The labyrinthine and basicranial shapes were clearly correlated in adult humans. The correlation coefficients were higher when the relative size, position, and orientation of the two sets of coordinates were taken into account. In the cranial base, labyrinth morphology varies mostly with the petrous pyramids.

This intraspecific trend in humans is consistent with the ontogenetic trend but partly contrasts with the phylogenetic pattern, especially regarding the basicranial flexion. These findings caution against functional interpretations of labyrinthine shape isolated from the shape and orientation of the cranial base.

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Reduction of the ulnar styloid process in primates and sloths: is it really convergent?

PIERRE LEMELIN

Department of Surgery, University of Alberta

A reduced ulnar styloid process characterizes the proximal carpal joint of hominoids, lorises, and sloths. This reduction minimizes contact between the ulna and triquetrum, which in turn is believed to enhance the range of motion of the hand during suspensory behaviors such as climbing. To better understand the functional role of a reduced ulnar styloid process, radiographs of the hand in different positions were taken on anesthetized gibbon, lorises, and sloths, as well as a sample of lemur and monkey species all sharing an ulnotriquetral joint. Displacement of the carpals with changing hand positions is compared between taxa. In contrast to other primates examined, ulnar deviation of the hand in the gibbon and lorises produces free movement of the triquetrum that accompanies translation of the scaphoid and capitate at the proximal carpal joint, as well as rotation (with some translation) of the capitate and hamate at the midcarpal joint. In sloths, the triquetrum shows little movement during ulnar deviation. Instead, this enlarged and cuboidal-shaped carpal acts as a mortise onto which the highly curved hamate can translate during ulnar deviation of the hand. Although the link between reduction of the ulnar styloid process and suspensory behaviors is still valid, the functional reasons underlying this reduction are different. Reduction of the ulnar styloid process in sloths appears to accommodate an enlarged triquetrum rather than promoting triquetrum movement as in primates. These data evince the importance of experimental data for interpreting key postcranial features of primates and other mammals.

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Gamer's dice and complex traits: Undergraduate classroom activity for increasing comprehension of genetic complexity

JULIE J. LESNIK

Department of Anthropology, Wayne State University

This classroom exercise aims to help students understand the three p's of genetic complexity: polymorphic, polygenic, and pleiotropic. Using coin flips and dice rolls, students are able to generate the genotype and phenotype of a random individual. From there, students find a mate for this individual and determine the phenotype of their offspring. Randomness generated by the coin and dice mechanics illustrate the principles of independent assortment and segregation, polygenic expression, and environmental effects. Using the example of melanin production for skin color, students are able to visualize the genetic contributions of two parents to the genotype of their offspring, helping students comprehend why phenotypes portray a blending of their parents traits while being based on particulate genetic information. When this exercise was introduced to a lecture-based classroom of 83 students where students worked in groups of five to six, grades on the subsequent exam improved. Test scores the semester with the activity were significantly higher than scores the previous term, with no other notable differences in the curriculum or exam quality. Class average was only slightly higher (86% versus 85%), but standard deviation reduced because zero students failed the exam as opposed to six students the previous year. This activity is easy to implement using the worksheets available online at entomoanthro.org and additional materials are inexpensive to procure. Dedicating more time to human genetics in an introductory course helps students become more comfortable with science and gain a better understanding of human variation.

Anomalous Molars in the Shiloh Cemetery Sample: A Differential Diagnosis

KRYSTLE N. LEWIS

Anthropology, Texas State University San Marcos

Mulberry molars are described in the literature as primarily affecting permanent first molars, and being highly indicative markers of congenital syphilis-along with Hutchinson's incisors, saber shins, frontal bossing, and depression of the nasal bones or "saddle nose."

In 1993, a flood exposed the skeletal remains of 11 individuals estimated to be African American subadults/young adults from the late 1800's buried in Shiloh Methodist cemetery in Missouri. Some Shiloh individuals exhibit anomalous molars characterized by abnormal enamel formation, crenulations with a 'melted' appearance, and a size reduction occurring in the upper and/or lower dentition. However, they do not appear to have any other evidence of congenital syphilis upon first glance. This study intensively assessed the sample in an effort to confirm a diagnosis. Visual observations of the mandibular and maxillary dentition were made to assess the presence, absence, and location of dental anomalies. If anomalous molars were present, the cranium and tibiae were also assessed for additional signs of congenital syphilis.

Out of the 11 individuals, three exhibited anomalous molars-mostly on the first molars. One individual may have also exhibited frontal bossing and "saddle nose." No evidence of saber shins was present. The anomalous molars in the Shiloh sample are not "typical" of definitions (early and recent) or images referring to mulberry molars. However, some research has documented and identified similar-looking molars as mulberry molars. Congenital syphilis could not be ruled out as a cause of the molars, however, differential diagnoses of amelogenesis imperfecta and Nance-Horan Syndrome were also considered.

Trial and Error: Addressing the Advantages and Limitations of 3D Modeling for Bioarcheological Samples

PATRICK J. LEWIS[1], SAMANTHA MITCHELL[2] and EMILY DE SANTOS[2]

[1]Biological Sciences, Sam Houston State University, [2]Department of Sociology, Anthropology, and Social Work, Texas Tech University

Photogrammetric modeling has increased in popularity across an array of anthropological research endeavors in the past decade. Many researchers are finding photogrammetry effective and affordable. Recently, bioarchaeologists have used 3D modeling to curate and analyze skeletal remains. However, photogrammetry presents a unique set of challenges for inexperienced researchers desiring to create photogrammetric and 3D printing stations in their laboratories. To date, simple photogrammetry has not yet been fully evaluated for curating bioarchaeological samples with varying preservation. This project carefully explores the limits of photogrammetry and 3D printing methods to analyze and curate bioarchaeological samples. To test the applicability of photogrammetry and 3D printing, a series (n=26) of tarsals, carpals, metacarpals, and metatarsals recovered from the archaeological site of Chan Chich in northwest Belize were photographed and modeled. Skeletal remains were photographed and models were created using Agisoft Photoscan. Resultant models were 3D printed as a means of preserving skeletal remains for curation and future educational tools. Results indicate that while simple photogrammetry is relatively budget-friendly and effective, it necessitates comprehensive photography skills to create quality models. Importantly, bioarchaeological samples are challenging objects to capture due to surface reflectivity, shape irregularities, and variable surface erosion. This paper also discusses useful approaches for software post-processing to aid in the creation of quality 3D skeletal models for low-budget laboratories. Results caution utilizing simple photogrammetry as the sole method of skeletal curation and analysis without consideration of the limitations of current photogrammetric methods.

Sexual dimorphism and the rise of male dominance

REBECCA J. LEWIS[1], E. CHRISTOPHER KIRK[1] and ASHLEY GOSSELIN-ILDARI[2]

[1]Anthropology, University of Texas at Austin, [2]Evolutionary Anthropology, Duke University

Sex-based power inequality is pervasive in human and nonhuman societies. This inequality has been hypothesized to be both a cause and a consequence of sexual dimorphism. We analyzed intersexual power, body mass ratio, and canine length ratio data for 79 extant primate species using phylogenetic logistic regression. While body mass and canine dimorphism were significant predictors of both male and female dominance, female power was not associated with female-biased dimorphism. Female-dominant species exhibited body mass monomorphism (mean=1.02±0.11) and male-biased canine size dimorphism (mean=1.14±0.36), and male-dominant species exhibited male-biased body mass dimorphism (mean=1.48±0.11) and male-biased canine size dimorphism (mean=1.97±0.80). Thus, greater intersexual power is not necessarily the result of greater fighting ability. Ancestral state reconstructions indicate that male dominance likely evolved in the last common ancestor of anthropoids prior to the evolution of extreme dimorphism. Reduction in dimorphism within anthropoids was often associated with shifts from away from male power.

Humans exhibit derived reductions in body mass and canine dimorphism, which are compatible with all patterns of intersexual power. Variability in human intersexual power may therefore be partly explained by (1) the absence of strong morphological constraints predisposing human societies to male dominance and (2) variation in demographic and mating patterns. However, upper body strength is argued to be highly dimorphic in modern humans and to therefore be more relevant than body mass for understanding the evolution of human intersexual power. We explore this hypothesis in the contexts of comparative analysis and cultural manipulation of plastic traits.

Bone strength properties of the calcaneus and navicular in leaping galagids

KRISTI L. LEWTON[1,2] and BIREN A. PATEL[1,2]

[1]Department of Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [2]Human Evolutionary Biology Section, Department of Biological Sciences, University of Southern California

Some small-bodied leaping primates (i.e., galagids and tarsiers) have an elongated navicular and distal calcaneus that improve leap performance for greater distance and velocity. Leaping also tends to incur take-off and landing forces that are several orders of magnitude larger than those experienced during quadrupedal behaviors. These higher forces could potentially generate higher bending loads on elongated tarsals, which could increase risk of bone failure. It is unclear, however, if habitual leaping with higher forces leaves a morphological signature of increased tarsal strength when compared to quadrupedal taxa with relatively shorter tarsals. This study tests the hypothesis that relative distal calcaneus and navicular bending strength is greater in galagids that leap (i.e., *Galago*) versus more quadrupedal taxa (i.e., *Otolemur*). Using microCT scans, section modulus and cortical area were calculated from slices representing the 50% position of distal calcaneal segment length and navicular length. Section modulus, a proxy for bending strength, was scaled by the product of body mass and bone length while cortical area, a proxy for bone mass, was scaled by total cross-sectional area. Contrary to predictions, relative bending strengths of the calcaneus and navicular are lower in leapers compared to quadrupeds, while relative cortical bone mass does not differ between groups. These results suggest that for small-bodied specialized leapers, gains achieved in locomotor performance by having elongated tarsals may outweigh any negative effects of high bending loads, or, that leaping forces, albeit higher than quadrupedal forces, do not increase tarsal bone failure risk.

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Odontogenic Abscesses in Rhesus Macaques (*Macaca mulatta*) of Cayo Santiago

HONG LI[1,2], WENJIN LUO[1], ANNA FENG[3], MICHELLE L. TANG[4], TERRY B. KENSLER[5], ELIZABETH MALDONADO[5], OCTAVIO A. GONZALEZ[6], MATTHEW J. KESSLER[7], PAUL C. DECHOW[1], JEFFREY L. EBERSOLE[8] and QIAN WANG[1]

[1]Department of Biomedical Sciences, Texas A&M University College of Dentistry, [2]Department of Endodontics, Capital Medical University School of Stomatology, Beijing, [3]Pre-dental Scholars Program,

Marquette University, [4]Department of Chemistry and Biochemistry, Georgia Institute of Technology, [5]Caribbean Primate Research Center, University of Puerto Rico Medical Sciences Campus, [6]Center for Oral Health Research & Division of Periodontology, University of Kentucky College of Dentistry, [7]Office of Laboratory Animal Resources, West Virginia University Robert C. Byrd Health Sciences Center, [8]School of Dental Medicine, University of Nevada Las Vegas

Odontogenic abscesses are one of the most common dental diseases causing various maxillofacial skeletal lesions and affecting an individual's ability to maintain the dental structures necessary to obtain adequate nutrition for survival and reproduction. In this study, the prevalence and pattern of odontogenic abscesses were investigated using skeletons from adult rhesus macaques of the free-ranging colony on Cayo Santiago Island. It was hypothesized that the prevalence of odontogenic abscesses is different among the sexes, different family lineages, and different time intervals in the history of the colony. The specimens were 752 adult rhesus macaques, aged 8 to 31 years, born between 1951 and 2000, from 66 matrilines. Fistulae or skeletal lesions caused by odontogenic abscesses drainage were evaluated visually. Seventy two specimens had odontogenic abscesses of varying severity, with the overall prevalence of 9.57%. Males had a significantly higher incidence than females. The prevalence of odontogenic abscesses in individual matrilines was significantly higher than in the population as a whole. Animals born between 1950 and 1965 tended to have a high incidence of odontogenic abscesses than those were born in later periods (1966-1995). These results suggest that oral pathologies in rhesus macaques are fairly common, as in humans, which may indicate familial effects interwoven with ecological and social factors. To better understand the epidemiology of these diseases in the human population, further assessments of the role played by environmental and familial effects on oral health and disease are warranted using more specialized and advanced studies that include adaptation and evolution.

Birthing Inequality: Disparities in Maternal Health at Home and Abroad

KYLEA L. LIESE and CRYSTAL L. PATIL

Women, Children and Family Health Sciences, University of Illinois Chicago

Three decades after the adoption of the Safe Motherhood Initiative, global trends in maternal mortality have declined significantly. Recent analyses have revealed a more complex picture of disparities in maternal health access, outcomes and experiences. Women's health is often framed as a construct of the choice to access and utilize appropriate health care during antepartum, intrapartum and postpartum periods. However, even within a health care system, disparities in maternal mortality often fall along the lines of social constructs: geopolitical boundaries, ethnic/racial divisions, socio-economic class. For example, in the US, women of color are at 5.2 times greater risk of death and severe morbidity from pregnancy-related causes than US-born white women. What is the relationship between the provision of obstetric care, women's choices, and disparities in maternal morbidity and mortality? This paper presents ethnographic and secondary data from the US and abroad on how structural frameworks embedded within health care and society shape reproductive experiences and outcomes during each interval of pregnancy: antepartum, intrapartum and postpartum. We use three examples to illustrate how disparities are produced: access to prenatal care in Tanzania, maternal mortality in Afghanistan and racial disparities in postpartum maternal morbidities in the United States. We close by tying these three disparate examples together with a discussion of how inequalities in women's reproductive health reflect larger themes of social inequality, policy and power, pushing the discussion away from individual choice to the context in which those choices are enacted or constrained.

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Exploring social inequality at petra through dental pathology

ALYSHA J. LIEURANCE and MEGAN PERRY

Anthropology, East Carolina University

Dental pathologies such as linear enamel hypoplasias (LEHs), periapical lesions, dental calculus and caries, and ante-mortem tooth loss (AMTL) can indicate physiological stress during childhood development as well as reflect biocultural markers of nutrition and oral infection. Combined, they provide a powerful indicator of differential access to resources and dietary variation. This research explores the frequencies of these pathologies in two samples from the ancient Nabataean capital city of Petra to illuminate their relationship to social stratification. The mortuary repertoire of Petra includes ornate monumental façade tombs surrounding the city center in addition to less elaborate shaft chamber tombs. Previous archaeological research explains these tomb variants as reflecting family groups of higher and lower social status, respectively. Statistical analysis of dental pathology frequencies in 654 teeth from the non-elite tombs and 232 teeth from the elite façade tombs identified statistically higher frequencies of dental calculus (X^2=29.750, p<0.0001), dental caries (X^2=6.869, p<0.0088), and LEHs (X^2=54.855, p<0.0001) in the elite façade tombs, and no differences in periapical lesions and AMTL. Our data show that higher status individuals likely had greater access to cariogenic foods containing fermentable carbohydrates such as figs, dates, and plums that proliferate the archaeological record. The higher frequency of LEHs suggests that the elite individuals more often experienced stress during childhood development. However, in reality more observations of LEHs point to a higher frequency of childhood stress survival. Unfortunately, the limited subadult remains from both contexts hinders understanding the relationship between LEH frequencies and childhood morbidity and mortality.

Non-territorial gibbons? Examining the effectiveness of territorial defense among white-handed gibbons (*Hylobates lar*) in Western Thailand

LYDIA E O. LIGHT and MARGARET SOBASZEK

Anthropology, University of North Carolina at Charlotte

The small apes of Asia are consistently described as highly territorial. However, white-handed gibbons (*Hylobates lar*) living in suboptimal habitat in Western Thailand occupy unusually large home ranges, with some groups failing to meet both the Mitani-Rodman and Lowen-Dunbar indices of defendability in certain months. This study aims to test the effectiveness of observed territorial defense in this population. We conducted behavioral observations of three habituated social groups between May 2012 and May 2013 in Huai Kha Khaeng Wildlife Sanctuary. We examine both intergroup encounters (IGE) and areas of exclusive use (AEU). In total, 26 IGEs were observed (Group A: 13, Group B: 6, Group D: 7). On average, IGEs occurred 96.1 meters (m) inside the home range border. IGEs for group A were significantly farther inside the home range border (112.9 m ± 25.6 m; $p \leq 0.02$) than group B (68.3 m ± 54.8 m) but did not differ significantly from group D (88.6 m ± 91.3 m) ($p > 0.05$). All three groups inhabited home ranges in which the AEUs were notably lower than the 75% estimates for white-handed gibbons at other sites (Group A: 67.2%; Group B: 67.4%; Group D: 59.5%). We conclude that, compared to other populations of white-handed gibbons, gibbons at our site defend a smaller proportion of their home range. We suggest that this relaxed territoriality may allow groups to lessen the costs of territorial defense in a habitat where the benefits of territoriality are unpredictable and vary greatly by season.

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Hidden variations that shape human skin barrier adaptation

YEN-LUNG "ONTA" LIN and OMER GOKCUMEN

Biological Sciences, University at Buffalo

Skin harbors some of the most significant adaptive variations in humans as our species colonized different ecologies. Indeed, amazing trends have been documented for adaptive evolution of ancient pigmentation genes. However, skin barrier function, the thickness and permeability of human skin, has yet to be investigated in an anthropological genetics framework. To fill this gap, we investigated the evolutionary trends that shape the genetic variation in the epidermal differentiation complex (EDC) on chromosome 1, which harbors more than 50 genes with known roles in skin barrier function. Our previous analysis of two of these genes, *LCE3B* and *FLG*, revealed an outsized effect of deletions and duplications of large genomic segments, affecting function in EDC. To further determine the evolutionary forces shaping this locus and the consequent skin barrier function, we adopted a two-layered approach. First, we conducted novel, long-read sequencing approaches to discover novel, previously undetected deletions and duplications. Second, we conducted model-based and empirical tests of neutrality across this locus to determine human-specific loci that have evolved under positive selection as compared to the great-ape ancestor, as well as variation among human populations that cannot be explained by neutrality alone. Our findings will help establish EDC as a human evolutionary innovation hotspot, primarily driven by copy number variations.

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The Peopling of the Ancient Andes

JOHN LINDO[1], RANDY HASS[2], COURTNEY HOFMAN[3], CHRISTINA WARINNER[4], MARK ALDENDERFER[5] and ANNA DIRIENZO[6]

[1]Anthropology, Emory University, [2]Anthropology, University of Maryland, [3]Anthropology, University of Oklahoma, [4]Anthropology, Max Planck Institute, [5]Anthropology, UC Merced, [6]Human Genetics, University of Chicago

The peopling of South America was likely an evolutionarily complex process, which included adaptation to various environmental factors—including high altitude, agriculture, and the effects of European contact. Here we present a time series of ancient genomes from the Andes of Peru, dating back to 7,000 years before present (BP), and compare them to unpublished modern genomes from both high and lowland populations. Using composite likelihood modeling methods, we infer a significant population collapse shortly after European contact in the Andes, although not as massive as previously predicted. We also find that the split between high and low altitude populations occurred roughly 9,000 years ago, which may indicate that hypoxia was not a strong barrier to early population movements given that human remains have been found in the Andes as early as 12,000 years BP. Lastly, we find evidence of positive selection in response to the adoption of agriculture and on immune genes after European contact. However, we do not find strong signals of positive selection in relation to hypoxia, which may suggest a polygenic adaptation.

Effects of habitat fragmentation on the behavioral ecology and population dynamics of Critically Endangered brown spider monkeys (*Ateles hybridus*) in Colombia

ANDRÉS LINK OSPINA[1,2,3], GABRIELA DE LUNA[3] and ANTHONY DI FIORE[3,4]

[1]Department of Biological Sciences, Universidad de Los Andes, [2]School of Business, Universidad de Los Andes, [3]Fundación Proyecto Primates, [4]Department of Anthropology, University of Texas at Austin

Given their slow life histories and highly frugivorous diets, spider monkeys (*Ateles* sp.) are extremely vulnerable to the effects of habitat fragmentation and degradation. Anthropogenic disturbances to natural habitats are often associated with lower food availability and stronger intraspecific competition, which may have dramatic consequences for animals' behavior, health, and survival. Here, we summarize results from a long-term study (2009-2017) of the behavior and ecology of a wild population of brown spider monkeys (*Ateles hybridus*) living in a heavily fragmented habitat at San Juan de Carare, Colombia. Compared with most other sites, spider monkeys at San Juan include a larger proportion of leaves in their diet (37%) year-round, and they rely heavily on figs as staple resources. Over the period of the study, the monkeys increased their average subgroup size, and the proportion of subgroups comprising >50% of group members rose from 17% in 2010 to 53% in 2012, suggesting that under habitat fragmentation, fission-fusion dynamics might no longer be sufficient to reduce competition for resources. In fact, contest competition has become more frequent, leading to the emergence of a dominance hierarchy amongst adult females. Finally, through eight years of demographic monitoring we have found that infant survival is low relative to spider monkeys living in less fragmented habitats and that group stability can be compromised by stochastic environmental events (e.g., floods) as well as by voluntary migration of individuals across natural barriers (e.g., pastures or rivers) to adjacent forest fragments, which can increase their vulnerability and compromise population viability.

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New cercopithecoid specimens from the early Miocene of Buluk, Kenya, and significance for dentognathic variation in the Victoriapithecidae

ELLIS M. LOCKE[1], BRENDA R. BENEFIT[2], ELLEN R. MILLER[3] and ISAIAH NENGO[4]

[1]Institute of Human Origins & School of Human Evolution and Social Change, Arizona State University, [2]Department of Anthropology and Sociology, New Mexico State University, [3]Department of Anthropology, Wake Forest University, [4]Turkana Basin Institute, Stony Brook University

The stem cercopithecoid *Noropithecus bulukensis* is known from 17 specimens collected at the early Miocene site Buluk, Kenya. Recent fieldwork at this site has yielded ~90 cercopithecoid fossils. Aside from the well-known middle Miocene taxon *Victoriapithecus macinnesi* from Maboko, Kenya, the fossil record of the Victoriapithecidae is comprised of small samples of poorly-preserved dentognathic remains. The Buluk specimens provide the opportunity to further explore variation in the teeth and jaws of stem cercopithecoids. Here, we describe the morphology of previously undocumented tooth positions of the Buluk cercopithecoid, including the upper central incisor, canine, and P3. We compare this new material with other stem cercopithecoids, including unpublished material of *Victoriapithecus* from Maboko, and re-evaluate diagnostic characters of *Noropithecus*.

Results show that variation in the cercopithecoid fossils from Buluk does not exceed that seen in other victoriapithecids and suggests the presence a single cercopithecoid taxon at this site. There is considerable size overlap and morphological similarity between the dentitions of *N. bulukensis* and *V. macinnesi*. New maxillary specimens reveal that upper dental arcade shape is variable and does not differentiate *Noropithecus* and *Victoriapithecus* as previously described. New mandibular specimens from Buluk confirm that the mandibular symphyseal shape of *Noropithecus* is distinct from the cercopithecine-like symphysis of Victoriapithecus. This remains the most reliable trait distinguishing these two genera and is not readily explained by differences in dental morphology or inferred diet. Additional discoveries of craniofacial and postcranial material will be critical for assessing the difference between the Maboko and Buluk cercopithecoids.

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How are human remains and digital data perceived by the public: an international survey of museum visitors

ANNABELLE L. LOCKEY[1], CARA C. HIRST[1,2] and SIAN E. SMITH[3]

[1]Department of Anthropology, University College London, [2]Institute of Archaeology, University College London, [3]Department of Security and Crime Science, University College London

Previous research has typically focussed on the opinions of academic researchers and curators regarding the treatment and ethical considerations of 3D digital displays and prints of human remains. It has been generally assumed by the academic researchers that 3D prints do not require the same ethical considerations of human skeletal tissue. However, this has been determined by researchers with a vested interest in the use of 3D prints and justification for these conclusions are not provided. This study involved an online survey of museum visitors, with questions relating to their views on human remains and digital data. Participants were asked their opinion on a series of real-life uses of human remains, digital and 3D printed human remains. Following these scenarios, participants were asked if these cases have influenced their opinions on human remains research. This was to determine if the lack of standardised ethics in human remains research may alter public perception. The aim of this study is to determine public opinions concerning ethics on the use of human remains both for academic research, museum displays and outreach. Results from this study determined that the majority of the sample were positive about human remains on display in museums and human remains research. Opinions on the scenarios varied significantly and were found to influence perception of human remains research. It was concluded that clear ethical guidelines are required for both human remains research and for 3D digital and printed human remains data in order to preserve public perceptions of this research.

Out of the box: A critical evaluation of the forensic anthropologist's skeletal remains storage standards

DAYANIRA LOPEZ, ELIZABETH A. ARMEROS and HEATHER WALSH-HANEY

Justice Studies, Florida Gulf Coast University

Skeletal material being reassessed has provided evidence that curation methods previously practiced are no longer suitable for long-term storage of remains. Cardboard boxes, newspaper, plastic bags and tin containers used by Dr. William R. Maples at the C.A. Pound Human Identification Laboratory presented with insect contamination, postmortem breakage due to shifting of remains within boxes, and changes in pH levels of the materials. Current curation methods include the use of the following materials: acid free boxes, archival boxes, corrugated polypropylene coroplast boxes, 100% cotton quilt batting, polyester quilt batting and polyethylene foam sheeting. Insect activity, temperature, and humidity of storage facilities are regulated and monitored.

The pH levels of 17 carboard boxes, a paper bag, fecal samples, and storage tin were tested to determine if pH levels gradually decreased. The results of the statistical analysis revealed that pH levels [N = 21; M = 7.05] are significantly affected by the number of elapsed years [α = 7.56249; β = -0.03032; p = 0.0275] with 23% total variation in pH explained by number of elapsed years [Multiple R-Squared = 0.2308]. A negative correlation evinced in the results lend to the conclusion that the integrity of the packaging materials may have become compromised over time.

Recommendations for proper curation standards of academic labs and medicolegal institutions suggest a periodic examination of the pH values of storage materials to verify acceptable levels. Implementations of contemporary standards are necessary for the sufficient curation of human remains as new materials and data become available.

Cultural cranial modification and social complexity in prehistoric and protohistoric Cyprus

KIRSI O. LORENTZ

Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute

The evidence for intentional cultural cranial modification (CCM) in prehistoric and protohistoric Cyprus has not yet been systematically published. The hypothesis that this body modification practice presents as universal during the early prehistoric periods, and becomes differential in the context of more complex societies towards the end of the prehistoric period in Cyprus, is explored. This analysis of CCM in Cyprus is based on 421 crania (N=421), from 36 sites, ranging from the Cypro-PPNB to the Cypro-Archaic. The crania were assessed macroscopically and metrically, and seriated in terms of extent of CCM within the three different types of CCM identified in Cyprus (antero-posterior [AP], circumferential [C], post-bregmatic [PB] CCM).

During the Khirokitian Neolithic the AP type CCM presents with universal population prevalence. During Early and Middle Bronze Age AP is frequent, but never approaches universal, and is more moderate than in the Khirokitian. During Late Bronze Age the AP type occurs sporadically, with no cases from the Iron Age. The PB type (occurs Late Bronze Age to Iron Age) is never universal throughout a mortuary population, although prevalence in individual tombs may be high. The C type occurs rarely, during Late Bronze Age only, and the two tombs at Enkomi and Bamboula with C type also contain individuals with PB.

CCM is key to understanding bodily identities, the elaboration of gender, status, and socio-cultural group affiliation, and how the signification of such bodily identities evolved in the context of increasing social complexity (from prehistoric agrarian societies to protohistoric urban societies).

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Trouble in paradise: analyzing the patterns of a bites and scratches directed at humans by long-tailed macaques (*Macaca fascicularis*) at Padangtegal Wenara Wana, Bali, Indonesia

JAMES E. LOUDON[1], MICHAELA E. HOWELLS[2], I. NENGAH WANDIA[3], I.G.A. ARTA PUTRA[3], MAYA R. CRUDUP[2] and AGUSTIN FUENTES[4]

[1]Anthropology, East Carolina University, [2]Anthropology, University of North Carolina-Wilmington, [3]Primate Research Center, University of Udayana, [4]Anthropology, University of Notre Dame

One potential avenue of disease transmission between humans and alloprimates is physical contact. Bites and scratches may be hazardous when the skin is broken, providing a possible macaque to human pathogen transmission. Direct contact with humans also places macaques at risk of possible human to macaque pathogen exchange. The Padangtegal Sacred Monkey Forest is inhabited by >700 long-tailed macaques (*Macaca fascicularis*). Padangtegal is visited by ~750,000 tourists annually, and each day numerous people feed, tease, and take photos with the macaques. These encounters frequently result in physical contact for both species, and sometimes bites and scratches. Injured tourists may seek care at the Padangtegal First Aid Clinic. Here, we present clinic injury data from 2012-2017. In total, 1,574 people from 69 countries sought care. Most injuries required cleaning with iodine and a bandage and only ten people were taken or referred to a doctor. Observations of human-macaque interactions at Padangtegal reveal that a minute proportion of injured tourists report to the clinic and most wounds go unassessed. Research at temple sites in Southeast Asia have revealed that simian foamy virus has rarely transferred from macaques to humans in high intensity contact areas. However, no instances of transmission from other *M. fascicularis*-borne viruses have been recorded. Macaques do acquire parainfluenza, measles, adenovirus, and mumps from humans. These viruses are spread via respiratory droplets, allowing for the possibility of re-transmission to humans. Interconnections between international tourists, local people, and macaques at Padangtegal result in complex dynamics for potential patterns of pathogen exchange.

Testing new methods on old bones: Searching for malaria in Archaeological material using a multi-dimensional approach

ALVIE LOUFOUMA[1,2], MICHELLE GAMBLE[2], MICHAELA BINDER[2], FRANK MAIXNER[3], HARALD NOEDL[1] and ALBERT ZINK[3]

[1]Center for Pathophysiology, Infectiology and Immunology, Medical University of Vienna, [2]Department of Bioarchaeology, Austrian Archaeological Institute, Austrian Academy of Science, [3]Institute for Mummies and the Iceman, European Academy of Bolzano/Bozen

Malaria, despite being one of the oldest and widespread diseases affecting humans, is relatively poorly understood in regards to its evolutionary history, as its systematic identification in ancient human remains is difficult and yet poorly understood.This research aims to provide biomolecular evidence of *Plasmodium* in human skeletal material from Egypt, dated to the 2nd and 6th centuries AD using Next Generation Sequencing (NGS), ELISA and malaria antigen Rapid Diagnostic Test (RDT) for the detection of *Plasmodium falciparum* antigen HRP2. Metagenomic analysis of the shotgun NGS sequencing data provided first indications for the presence of Plasmodium DNA in four out of 20 samples. Furthermore, Capture of mitochondrial DNA of Plasmodium by using multiplex DNA Sequence Capture will be performed and undertaken, to make the results more reliable and significant. In parallel, various approaches of protein extraction and the extracts used on two types of RDTs and ELISA have produced mixed results (positive with one type of RDTs and negative with another Type of RDTs and ELISA), providing insight into the efficacy and reliability of this method in the detection of the Plasmodia parasite in ancient bones and teeth. These findings represent a contribution to the overall number of aDNA results for the Plasmodia parasite and will aid in the refinement of the biomolecular techniques used to identify the parasite.

This project is supported by Innovation fund of the Austrian Academy of Sciences

Potential Medicinal Properties of Plants Consumed by Mountain Gorillas (*Gorilla beringei*) in Bwindi Impenetrable National Park, Uganda

SARA G. LUCCI and JESSICA ROTHMAN

Department of Anthropology, Hunter College of the City University of New York, New York

Although plants in primate diets are usually eaten for their nutritional benefits, they also may have medicinal properties that improve health. This study sought to determine the possible medicinal properties of plants eaten by mountain gorillas (*Gorilla beringei*) at Bwindi Impenetrable National Park, Uganda. Through a literature review and interviews with local field assistants, we identified that 70% of foods eaten by gorillas were used by local communities for medicine. Among the uses of these plants are treatments for: gastrointestinal ailments (30%), skin diseases (17%), gynecological problems (10%), respiratory issues (11.7%), and malaria (8.3%). The literature provided information on 38.3% of these plants. Namely we found that several plants had anti-oxidant (10%), anti-bacterial (8.3%), anti-viral (5%), and anti-plasmodial (11.7%) properties. Our study revealed that gorillas consume a diet that includes plants with medicinal benefits to humans. While no evidence of intentional medicinal plant use has been found (as in other ape populations), our results demonstrate that their diet could provide important health advantages.

Open-canopy habitats at Karungu, Kenya: an early Miocene fossil site with few primate remains

WILLIAM E. LUKENS[1], THOMAS LEHMANN[2], DANIEL J. PEPPE[1], DAVID L. FOX[3], STEVEN G. DRIESE[1], RAHAB KINYAJUI[4], JOHN D. KINGSTON[5] and KIERAN P. MCNULTY[6]

[1]Geosciences Department, Baylor University, [2]Messel Research and Mammalogy Department, Senckenberg Research Institute and Natural History Museum Frankfurt, [3]Department of Earth Sciences, University of Minnesota, [4]Earth Sciences Department, National Museums of Kenya, [5]Department of Anthropology, University of Michigan, [6]Department of Anthropology, University of Minnesota

Early Miocene outcrops near Karungu, Western Kenya, preserve fluvio-lacustrine landscapes that contain abundant fossils of terrestrial and aquatic vertebrates. Primates are notably rare among these remains, although contemporaneous strata on Rusinga Island contain rich assemblages of fossilized catarrhines. To explore possible environmental controls on the occurrence of early Miocene primates, we analyzed the stratigraphy, sedimentology, paleopedology, and paleontology at Karungu. Sedimentary units range from fully terrestrial alluvial facies to shallow and deepwater lacustrine facies. Most fossils are associated with meandering fluvial channels, though exceptions include beach strandlines and microvertebrates in floodplain paleosols.

Paleoclimate estimates indicate subhumid and hyperthermic conditions based on paleosol elemental proxies, temperature-sensitive taxa, and comparison to nearby fossil floras. The carbon stable isotope composition of pedogenic carbonates ($\delta^{13}C_{cc}$) varies from −10‰ to −5.5‰ for most stratigraphic levels, indicating vegetation dominated by either water-stressed C_3 plants or a mixture of C_3 and C_4 photosynthesizing vegetation. One anomalous interval occurs in association with a microvertebrate assemblage, where $\delta^{13}C_{cc}$ values reach −1.9‰, consistent with ~50% C_4 biomass. Common microcharcoal grains, herbaceous root traces, and phytolith assemblages corroborate stable isotope data and are consistent with an open canopy biome. The microvertebrate assemblage contains a number of taxa that support an open floodplain environment with little wood cover, including grazing elephant shrews (*Myohyrax*), saltatorial springhares (*Megapedetes*. *Rusingapedetes*), and hydrophilic cane rats (*Paraphyomys*).

Taken together, paleoenvironments at Karungu were likely dominated by seasonal open woodlands to woody grasslands. We hypothesize that environmental preference was the key driver in the occurrence of catarrhine communities.

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The Construction of Genetic Identity in the United States

JUSTIN LUND

Anthropology, University of Oklahoma

Popular media bombards the public with various direct-to-consumer (DTC) genetics tests that claim to tell you everything you may want to know from the likelihood of your athletic ability to your genetic ancestry. Because the services of these companies are considered recreational in nature, there is little to no oversight in how they conduct their analyses. DTC genetic testing has become very popular, but the ethical implications have not been thoroughly discussed. In Alondra Nelson's work in African-American contexts, she has found that these tests can reconcile families' histories and can even provide a type of healing to historic traumas. However, for Native Americans the racial logics of identity have been institutionalized differently than that of African-Americans. In this work, I argue that the genetic identities suggested by DTC genetic testing function as a mechanism for erasing indigenous identity and thus become another technique of settler colonialism.

Patterns of relative olfactory turbinal surface area through Euarchonta

INGRID K. LUNDEEN

Department of Anthropology, The University of Texas

Olfactory system reduction is well known as one of the major shifts in primate evolution. The timing of this shift is relatively poorly understood which may relate to the olfactory system having relatively few anatomical proxies that preserve in fossil taxa. Comparative studies of olfactory bulbs suggest that reduction occurred in early haplorhine primates while recent genomic work suggests a decrease in olfaction in crown primatomorphans. Here, olfactory turbinal surface area (OTSA) is used as a proxy for olfactory epithelium, the sensory neuron-containing region of the nose. Patterns of OTSA are examined across

euarchontans to test hypothesized reductions in olfactory sensitivity between 1) tree shrews and primatomorphans (primates and flying lemurs), and 2) strepsirrhines and haplorhines. The olfactory turbinals of non-primate euarchontans (tree shrews and flying lemurs), strepsirrhines (lemurs, lorises, and galagos), and haplorhines were segmented from µCT scan data and OTSA was measured using tools in Avizo 9.1. While preliminary data show no significant difference between primatomorphans and tree shrews or between strepsirrhines and haplorhines, there is a substantial difference in OTSA variation in lemurs compared with lorises and galagos. This finding may reflect the diversity in activity patterns and diets seen in lemurs as compared to lorises and galagos. Relatively greater OTSA is found in the nocturnal haplorhine, *Aotus*, compared to other haplorhines, potentially reflecting the importance of olfactory cues in nocturnal environments. These findings suggest that OTSA may be a more informative proxy within individual primate clades than it is across Euarchonta.

TEAL of Dreams: If you build technology enabled active learning classrooms, they will come

SABRINA LUTE, JAMES VANDERVEEN and JOSHUA WELLS

Anthropology and Sociology, Indiana University of South Bend

Colleges and universities must meet the needs of introductory classes, such as Human Origins, meant for students fulfilling general education requirements. These large classes struggle with student retention (higher withdrawal rates) and mild academic success (measured in terms of GPA). Over the course of several years, Indiana University of South Bend, a moderately-sized commuter campus, initiated smaller, technology enabled active learning (TEAL) Human Origins classes and recorded statistical data regarding the success of this alternative to large, lecture courses. A 30-minute instructor lecture provided key points as a prompt at the beginning of class, while online activities, many intended for in class time only, aided in reinforcing the lecture. Integrated methods of teaching were sourced from a range of materials and enabled students to adopt new methods for research, while coordinating and presenting research on shared platforms. Students accessed an array of online materials and studies, produced information, and created questions from online materials which were shared and answered via open-access software. Additionally students were able to further technological proficiencies through applied active learning. Students were administered surveys throughout TEAL classes which provided supplemental data sets that further supported research data. Results from this research were encouraging with both a decrease in withdrawals and increase in overall GPA. Though a large, lecture based course is efficient in terms of teaching resources, our evidence suggests that small, technology enabled active learning classes provide better opportunities.

"Culture flow": The role of rivers in cross-community cultural transmission in the Upper Amazon

STEPHEN J. LYCETT and KERSTIN SCHILLINGER

Anthropology, University at Buffalo

Rivers are known to play a role in human subsistence, economic, transport, and communication dynamics in many regions of the world. However, there has been little systematic investigation of how landscape features such as rivers might structure cultural transmission, such that this has a direct influence on cross-community patterns of variation, equivalent to that known for genetic transmission. Here, we statistically explore the influence of river networks on patterns of inter-community cultural variation by utilizing spatial, linguistic, and artifactual data from linguistically diverse peoples of the Upper Amazon region, using an ethnographic dataset. When the geographic ("straight line") distances among groups were controlled for, our statistical analysis found no relationship between inter-group material culture patterns and linguistic variation. We did, however, find a statistical relationship between the geographic distances among ethnolinguistic groups and their overall similarity as measured by material culture. This suggests that geographic distance is a more important factor in influencing pathways of cultural transmission among groups than language across the region. Most importantly, however, our analysis also found a significant relationship between riverine distances among ethnolinguistic groups and their material culture patterns. This relationship remained statistically significant even when taking both language variation and geographic (straight line) distances into account. Hence, these results support the hypothesis that rivers are having an influence on pathways of cultural transmission, and that they ultimately contribute to the structure of cultural variation observed across the region.

Seasonal variation in arthropod abundance and consumption by omnivorous guenons in Kibale National Park, Uganda

MARTHA M. LYKE[1], ANTHONY DI FIORE[2], NOAH FIERER[3], ANNE A. MADDEN[4] and JOANNA E. LAMBERT[5]

[1]Anthropology, University of Texas at San Antonio, [2]Anthropology, University of Texas at Austin, [3]Ecology and Evolutionary Biology, University of Colorado Boulder, [4]Applied Ecology, North Carolina State University, [5]Anthropology, University of Colorado Boulder

Seasonality of food resources impacts food encounter rate, consumption, and overall diet composition, though specifics of arthropod availability remains poorly described. Here, we examine variation in arthropod availability and consumption by adult redtail (*Cercopithecus ascanius*) and blue monkeys (*C. mitis*) in Kibale National Park, Uganda, over a six-month period encompassing one wet and dry seasonal cycle. We sequenced arthropod DNA (reported here as presence only) from 221 fecal samples (redtails n=115, blues n=106) and estimated availability (relative abundance) from canopy trap (n=24) and sweep net (n=10) samples. We found that arthropod abundance was greater ($p<0.001$) during the wet than dry season. Lepidoptera abundance (adult and larvae) was also higher ($p<0.001$) in the wet season, however, fecal samples from both species contained more Lepidoptera during the dry season ($p<0.001$). Diptera abundance was greater in the wet season ($p<0.001$) and this was reflected in the blue monkey samples ($p<0.001$). Samples from both species contained more Araneae taxa during the wet season ($p<0.001$), and redtails more Coleoptera and Hymenoptera during the dry season ($p<0.001$), but we found no seasonal difference in abundance of these taxa. We also compared arthropod species richness per fecal sample and found redtail species richness significantly higher in the dry than wet season ($p<0.01$). While we report seasonal variation in the quantity and types of arthropod taxa consumed by these primates, our results indicate that arthropod availability does not co-vary with consumption: insect and other invertebrate consumption is important to both species year-round, regardless of availability.

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A test of the (hu)MANid sex and ancestry estimation program on a diverse sample of modern, historic, and prehistoric mandibles

PAIGE A. LYNCH[1], KELSEY A. CARPENTER[2], MICHAEL W. KENYHERCZ[3,4] and HEATHER M. GARVIN[5]

[1]Department of Applied Forensic Sciences, Mercyhurst University, [2]Department of Integrated Biomedical Sciences, Rush University, [3]Department of Defense POW/MIA Accounting Agency, Central Identification Laboratory, [4]Department of Anatomy, University of Pretoria, [5]Department of Anatomy, Des Moines University

The (hu)MANid program is a relatively new and free, web-based software developed by Berg and Kenyhercz (2017) that uses mandibular metric and morphoscopic variables to estimate the sex and ancestry of an individual through use of either linear discriminant analysis (LDA) or mixture discriminate analysis (MDA). The program's reference database consists of a

total of 1,745 individuals from 15 different populations (including modern, historic, and prehistoric groups). Berg and Kenyhercz (2017) report that of the statistical methods employed by the program that MDA performed best, with correct sex/ancestry rates up to 70.7%. The aim of this study is to assess the accuracy of the (hu)MANid program on a geographically and temporally diverse sample with data collected by a researcher other than one of the program developers.

Nine metric and morphoscopic mandibular measurements were collected from three-dimensional surface scans of mandibles collected from males and females from recent U.S. Black, recent U.S. White, recent Portuguese, medieval Nubian, and prehistoric Native American population groups (N_{total} = 505), and the variables run through (hu)MANid for sex and ancestry classification. Overall, MDA outperformed LDA. The average correct sex classification was 74%. For those test populations that had matching reference groups in the (hu)MANid database, correct ancestry classification ranged from 8 to 45% and correct sex/ancestry group ranged 3 to 41%. The Portuguese, which did not have a (hu)MANid matching reference group, most often classified as Hohokam prehistoric Native American (24%). In general, results suggest the program has potential, but needs further evaluation.

Fight the bite: Zika Virus, personal responsibility, maternal stigmatization, and disabled children in American Samoa

CHRISTOPHER D. LYNN[1], MICHAELA HOWELLS[2] and MARGARET SESEPESARA[3]

[1]Anthropology, University of Alabama, [2]Anthropology, University of North Carolina Wilmington, [3]Nursing, American Samoa Department of Health

Vertical transmission of Zika Virus from mother to fetus has been linked to long-term disabilities, fetal demise, and stillbirths. Maternal protection is dependent on community action to reduce vector breeding, condom availability, and access to healthcare education through early prenatal care. However, Zika protection and risk are frequently framed as individual responsibility even when structural inequalities prevent adequate protection across maternal and socioeconomic status. We use the recent Zika outbreak in American Samoa to explore the narrative of choice surrounding exposure and examine the relationship between maternal social status and access to prenatal care. In American Samoa, religious taboos ban sexual health education in school, challenge access to family planning, and stigmatize premarital sex and resulting pregnancies. Although the majority of Zika-focused preventative materials and education in this region are provided during prenatal visits, our research indicates significant differences in the timing, amount, and adequacy of prenatal care ($p>0.05$) based on maternal marital status. This is paired with narratives of choice and responsibility surrounding pregnancy and access to care. Economic challenges in accessing expensive preventative measures (insect repellant, air conditioning, screens) further increase vulnerability. Finally, we discuss the emerging challenge of fulfilling the growing need for appropriate medical services, testing, and education for children born to Zika-positive mothers in communities with minimal disability services infrastructure. Taken together, strides must be taken to ensure prevention, risk, and outcomes associated with Zika are not erroneously made the responsibility of individual mothers.

Bacterial succession inside marrow-containing bones as a tool for estimating PMI

AARON M. LYNNE, NICOLE RUBLE and PATRICK J. LEWIS

Biological Sciences, Sam Houston State University

Postmortem interval (PMI) is an essential part of forensic investigations, linking the stages of decomposition to time since death. Decomposition is driven by numerous biotic and abiotic factors that impact its rate. Recent research has improved the accuracy of PMI by using the succession of bacterial communities. These new methods are still subject to external variables and require the presence of soft tissues, however, making them impractical once a body has reached the dry stage. The interior of marrow-containing bones is protected from many of the variables that influence current PMI measures, and bones persist longer than soft tissues. A pilot study on three cadavers at the Southeast Texas Applied Forensic Science facility at Sam Houston State University examined microbial succession within bone marrow as an indicator of PMI. The femur, humerus, and ilium were sampled using a medical-grade bone marrow biopsy needle, with the left bones being sampled every 2 days and right bones sampled every 10 days as a control. The 16S rRNA gene of collected samples was amplified and sequenced via PCR and Illumina to identify bacterial communities. After examining this pilot data results point to a definite trend in community composition across the bones of all three cadavers as decomposition progresses. Bacteria was present inside the bones for several months and distinct trends in succession were observed. These results suggest the potential for improved methods for estimating PMI that are both better protected from external variables and useful long after soft tissues have decayed.

The Effect of Life History and Locomotion on Postcranial Growth

MARISA E. MACIAS

Anthropology, American Museum of Natural History

Growth and development is one of the most important components defining our life history. Differences in life history traits between species are hypothesized to be adaptive responses to past environments. Many studies have addressed the relationship between dental eruption and life history traits; however, dental development is not a highly reliable proxy for skeletal growth in modern humans. As dental eruption completes before epiphyseal fusion in *Pan troglodytes*, but after epiphyseal fusion in *Homo sapiens*, tooth eruption sequences are not sufficient for interpreting fossil hominins. Understanding growth over human evolution requires comparative research on nonhuman primates and their life histories. Although some patterns of epiphyseal fusion are shared among humans and African apes, it is unclear whether the unique patterns in humans are adaptive traits without comparative contextual data. I explore the influence of three main factors on variation in epiphyseal fusion: adult body mass, speed of growth trajectory, and locomotor adaptations in nine primate species. Larger species, e.g. *Gorilla gorilla*, delay epiphyseal fusion of the humerus as well as the os coxae to achieve greater stature. Primates range in their time to maturity from mere months to over a decade. The considerable range of variation in primates is a significant factor in understanding patterns of growth. Finally, timing of the fusion of centers of growth with several muscle attachments, such as the humeral epicondyle, is significantly related to arboreal locomotion. These features should be particularly useful for understanding life history of extinct taxa, including fossil hominins.

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The influence of development, energetics, and behaviour on the mechanical competence of the female skeleton

ALISON A. MACINTOSH[1], JONATHAN CK. WELLS[2] and JAY T. STOCK[1,3]

[1]Department of Archaeology and Anthropology, University of Cambridge, [2]Childhood Nutrition Research Centre, UCL Great Ormond Street Institute of Child Health, [3]Department of Anthropology, Western University

Women's bones need not only to be mechanically strong, but also to store sufficient minerals for pregnancy, lactation, and menopause. The influence of developmental parameters and mechanical loading on this balance in the limb bones of women has implications for the risk of fracture in later life, but this influence is not well-understood. This study assesses the role

of life history trajectory (via proxies for maternal investment and maturational rate) and behaviour on skeletal health and body composition among 111 young adult female athletes (soccer, running, rowing) and control subjects. Sports involving a moderate volume of high-impact and directionally-variable mechanical loading together provided the greatest benefits to both bone mineral status and cross-sectional mechanical strength in the limb bones of these women. Though physical activity was clearly one of the main determinants of bone strength in this group, birth weight and age at menarche also contributed significantly, independent of activity level. Those reaching sexual maturity earlier diverted resources to greater adiposity at the expense of skeletal size and mechanical competence, while lower birth weight also reduced mechanical competence. Thus, the level of maternal investment during a woman's fetal life and her life history trajectory during development both shape investment in skeletal properties, with physical activity then altering skeletal size-strength relationships when loading requires it. These results extend the influence of life history trajectory to fracture risk, and document the complex role of development and behaviour in contributing to women's skeletal mechanical competence.

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Shuar Childhood and Adolescent Bone Density Documented Across Varying Degrees of Market Integration

FELICIA C. MADIMENOS[1,2], MELISSA A. LIEBERT[3], SAMUEL S. URLACHER[4], CHRISTOPHER J. HARRINGTON[5], TARA J. CEPON-ROBINS[6], THERESA E. GILDNER[5], J. JOSH SNODGRASS[5] and LAWRENCE S. SUGIYAMA[5]

[1]Anthropology, Queens College (CUNY), Flushing, NY, [2]New York Consortium in Evolutionary Primatology (NYCEP), New York, NY, [3]Anthropology, Northern Arizona University, Flagstaff, AZ, [4]Anthropology, Hunter College (CUNY), New York, NY, [5]Anthropology, University of Oregon, Eugene, OR, [6]Anthropology, University of Colorado, Colorado Springs, CO

While health costs associated with Market Integration (MI) are well-documented among children and adolescents, there is less focus on how MI affects skeletal integrity. A consideration of sub-adults is important because peak bone mass is established in early life, and thus, sub-adults with low bone density will more likely become adults with higher osteoporosis risk. Developed within the framework that MI shapes behavioral and lifestyle factors (i.e., physical activity, diet) known to influence skeletal health, this study investigates bone density among 100 Shuar children and adolescents (ages 3-20yo) from three Amazonian Ecuadorian regions, each representing different stages along the MI spectrum: a small market town (high MI), a rural village with market access (intermediate MI), and a remote village distanced from market centers (low MI). In addition to anthropometrics (height, weight, BMI), speed of sound (SOS), a measure of bone density, was determined using a MiniOmni ultrasound targeting the radius and tibia. SOS values were converted into population-specific z-scores. One-way ANOVA tests identify significant regional differences in z-scores with highest radial and tibial BMD found in the low MI community, and lowest BMD in the market town ($p<0.01$). Regional differences were maintained when analyzed by sex at $p<0.001$ for the tibia, and $p<0.05$ for radial BMD among females, but not males. Preliminary results suggest that lifestyle characteristics associated with low MI may attenuate one's risk of developing low BMD. Findings also emphasize potential benefits in targeting preventative efforts against low bone mass and osteoporosis towards sub-adults.

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The biorhythm of human skeletal growth

PATRICK MAHONEY[1], JUSTYNA J. MISZKIEWICZ[2], SIMON CHAPPLE[1], MONA LE LUYER[1,3], STEPHEN H. SCHLECHT[4], TAHLIA J. STEWART[2], RICHARD A. GRIFFITHS[5], CHRIS DETER[1] and DEBBIE GUATELLI-STEINBERG[6]

[1]School of Anthropology and Conservation, University of Kent, [2]School of Archaeology and Anthropology, Australian National University, [3]De la Prehistoire a l'Actuel Culture Environment et Anthropologie (PACEA), University of Bordeaux, [4]Department of Orthopaedic Surgery, University of Michigan, [5]Durrell Institute of Conservation and Ecology, University of Kent, [6]Department of Anthropology, The Ohio State University

Evidence of a periodic biorhythm is retained in tooth enamel in the form of Retzius lines. The periodicity of Retzius lines (RP) correlates with body mass and the scheduling of life history events when compared between some mammalian species. The correlation has led to the development of the inter-specific Havers–Halberg oscillation (HHO) hypothesis, which holds great potential for studying aspects of a fossil species biology from teeth. Yet, little is known about the potential role of the HHO for human skeletal growth. Here, we explore this hypothesis within a sample of human skeletons. Associations are sought between the biorhythm and two hard tissues that form at different times during human ontogeny, using standard histological methods. First, we investigate relationships of RP to permanent molar enamel thickness and the underlying daily rate that ameloblasts secrete enamel during the early childhood years. Second, we develop preliminary research previously conducted on small samples of adult human bone by testing associations between RP, adult femoral length, and the rate of osteocyte proliferation. Results reveal RP is positively correlated with enamel thickness, negatively correlated with femoral length, but weakly associated with the rate of enamel secretion and osteocyte proliferation. These new data imply that a slower biorhythm predicts thicker enamel for children but shorter stature for adults. Our results develop an intra-specific HHO hypothesis suggesting a common underlying systemic biorhythm has a role in the final products of human enamel thickness and femoral length, probably through the duration rather than the rate of growth.

Genomic reconstruction of the history of extant populations of India

PARTHA P. MAJUMDER

Biomedical Genomics, National Institute of Biomedical Genomics

To shed light on the peopling of South Asia and the ancestries of the populations of India, including mainland and island, we have carried out analyses of 1.1 million SNP-chip and whole genome sequence data on a large number of ethnic groups from India. In carrying out the analyses, we have also collated relevant publicly-available data. Our analysis revealed that there are four dominant ancestries in mainland populations of India, contrary to two ancestries inferred earlier. We also show that (i) there is a distinctive ancestry of the Andaman and Nicobar Islands populations that is likely ancestral also to Oceanic populations, and (ii) the extant mainland populations admixed widely irrespective of ancestry, which was rapidly replaced by endogamy, particularly among Indo-European–speaking upper castes, about 70 generations ago. This coincides with the historical period of formulation and adoption of some relevant sociocultural norms. We also show that all Asian and Pacific populations share a single origin and expansion out of Africa, contradicting an earlier proposal of two independent waves of migration.

The Illusion of Choice: Barriers to Patient-Centered Care and Shared Decision Making in Obstetrics

DEENA MALLAREDDY

School of Nursing, Department of Family Health Care Nursing, UC San Francisco

The frameworks of shared decision making and informed consent have gained momentum in obstetrics, particularly in the last five years. Although most human labors and births, if supported in their normal physiological processes, result in favorable clinical outcomes, the "delivery" of person-centered frameworks in actual practice remains problematic. Larger structural inequities collude with specific peculiarities of the modern obstetrical environment and the birth process in general and contribute to

what this presentation will refer to as "the illusion of choice" along many decision-making points in the labor and birth experience.

Barriers to the transition to values-based, egalitarian, and relationship-centered approaches in real-time obstetrics will be explored using specific clinical examples by the presenter, a certified nurse-midwife who currently provides maternity care. The tension between maternal and fetal/newborn well-being, as well as structural inequities and the history of sociopolitical and medicolegal agendas in US obstetrics, will be discussed.

The presentation offers the anthropologist a novel, clinically based synthesis of well-discussed topics in the field, such as: the human pelvis as obstetrical dilemma, technocratic appropriation of the feminine, and the impact of obstetric violence (partly from lack of clear consent) on long-term health and attachment behaviors between female-bodied people and their infants. Existing theoretical approaches in medical and physical anthropology, regarding choice in health care decisions will be applied to clinical scenarios specific to the nurse-midwife's experience with undocumented immigrants, adolescents, incarcerated people, and the uninsured.

Seasonal changes in the metabolome of wild black howler monkeys (*Alouatta pigra*)

ELIZABETH K. MALLOTT and KATHERINE R. AMATO

Department of Anthropology, Northwestern University

Recent studies of black howler monkeys (*Alouatta pigra*) have shown that the gut microbiota helps buffer seasonal variation in energy and nutrient availability. However, host and gut microbial metabolism both contribute to an individual's nutrient and energy intake. Here we use gut metabolite profiles to examine seasonal differences in host and gut microbial co-metabolic pathways in response to changes in macronutrient intake. We collected behavioral data and fecal samples (n=81) from 16 black howler monkeys in Palenque National Park, Mexico during wet, fruit-dominated (WFD), dry, leaf-dominated (DLD), and dry, fruit-dominated (DFD) seasons. GC/MS analysis was used to profile metabolites in fecal samples. During the WFD season, individuals had increased energy intake, increased neutral detergent fiber intake, and a higher percentage of ingested dry weight was protein (ANOVA, all $p<0.01$) compared with the DFD season. However, total non-structural carbohydrates accounted for a higher percent dry weight ingested during the DFD season compared with the WFD season ($p<0.01$). Fecal metabolite profiles were significantly different between seasons (PERMANOVA, $R^2=0.269$, $p<0.001$). In the WFD season, metabolite profiles were enriched for metabolites related to glycerolipid and fatty acid metabolism. In the DFD season, metabolite profiles were enriched for starch and sucrose metabolism, as expected. However, despite decreased protein consumption in the DFD season, metabolite profiles were enriched for the metabolism of several amino acids. These results indicate that plasticity in co-metabolic pathways, likely due to microbial metabolism, may be compensating for shortfalls in protein consumption.

This study was funded by the National Geographic Society, National Science Foundation Graduate Research Fellowship Program, and the University of Illinois at Urbana-Champaign.

Periodic and accentuated enamel structures along with trace elemental distribution permit age assessments of dietary transitions in the dentitions of yellow baboons (*Papio cynocephalus),* chimpanzees *(Pan troglodytes schweinfurthii),* and red-tailed monkeys (*Cercopithecus ascanius)*

MAIRE MALONE[1], LAURA MACLATCHY[1], JOHN KINGSTON[1] and GUILLAUME GIRARD[2]

[1]Anthropology, University of Michigan, [2]Earth and Environmental Sciences, Michigan State University

The weaning process is a complex aspect of an organism's life history, and tracking dental evidence of weaning-related dietary changes presents a number of challenges. This study tested whether the occurrence of accentuated striae coincides with changes in trace element intensity in the inner enamel of first molars from members of the 3 study populations.

Microstructural and trace element data were obtained from the teeth of severalyellow baboons (*Papio cynocephalus)* from Loboi, Kenyaas well as a number of chimpanzees (*Pan troglodytes schweinfurthii*) and red-tailed monkeys (*Cercopithecus ascanius)* from Kibale National Park, Uganda. LA ICP-MS was used to obtain calcium-normalized barium and strontium ratios (Ba/Ca and Sr/Ca) from thin sections of first molars in order to detect and track the timing of dietary changes in members of these populations. Laser ablation was conducted at Michigan State University's ICP-MS laboratory. Qtegra software was used to analyze Ba/Ca and Sr/Ca levels from 85 micron-wide ablated tracks of enamel closest to the enamel-dentine junction (EDJ). Polarized light microscopy was used to measure periodic and accentuated enamel microstructures, and assess ages at dietary transitions for each individual.

In members of all 3 populations, the earliest forming accentuated striae in enamel coincided with areas of changing Ba/Ca levels, while the Sr/Ca intensity changes were more complex and will require further interpretation. These results permit precise ages at dietary transitions to be estimated and expansion of this method will allow continued exploration of the weaning process and overall life history in these and other taxa.

Time after time: individuals with multiple fractures in long eighteenth century London

MADELEINE L. MANT

Archaeology, Memorial University of Newfoundland

Investigating injury recidivism and individuals with multiple injuries is an area of growing interest in bioarchaeology. Differentiating between whether an individual sustained multiple injuries, represented by antemortem healed trauma, in one incident or in multiple incidents over the life course is a major challenge for bioarchaeologists. This research analyzed the skeletal remains of 721 adult individuals (402 males, 319 females) from five post-medieval (17^{th} to 19^{th} centuries) sites – three parochial cemeteries and two hospital cemeteries – from London, UK, known to include working class individuals. A total of 164 individuals (121 males, 43 females) had more than two fractures; males were significantly more likely to have multiple (2+) fractures than females in the middle and older adult age categories. Interestingly, there were no significant differences in the number of fractures found between the parochial and hospital cemetery groups. An investigation of fracture recidivism incorporating a relative timeline of fracture events was possible in this project because 14 individuals (12 males, 2 females) were identified who had a combination of healed, healing, and/or perimortem fractures. This paper examines the distribution and relative timing of these fractures, incorporating contemporary clinical as well as social and historical context, to encourage a broader understanding of injuries caused by accidents and interpersonal violence during a time of intense social, political, and economic change.

Chewing biomechanics in early Homininis: An approach to detect evolutionary change in the ecomorphological relationship between mandibles and diet

JORDI MARCÉ-NOGUÉ[1], ALEXANDER DAASCH[1], THOMAS A. PÜSCHEL[2] and THOMAS M. KAISER[1]

[1]Centrum für Naturkunde, University of Hamburg, [2]School of Earth and Environmental Sciences, University of Manchester

Planar mandibular models of 31 extant primate species, including hominoids, were biomechanically investigated using Finite Element Analysis (FEA). We tested the hypothesis that mandibular biomechanical traits exhibit a signal related to dietary traits such as the hardness of foods consumed regularly. We found that it was

possible to distinguish diet categories based on biomechanical performance.

Consequently, we though that it was possible to apply a similar approach in order to detect evolutionary trends in the biomechanical capabilities to handle stress in fossil hominin mandibles. Using a comparative framework, the same approach was applied to mandibular FEA models of 28 fossil individuals representing 16 taxa and 3.5 million years of hominin evolution. The carried out procedures were designed to allow the quantitative comparison of FEA data obtained from dissimilar models, combining both stress distribution maps and numerical values.

The following hypotheses were tested: 1) early (3.5-2.5ma) hominins show similar stress patterns as extant durophagous primates and 2) there is a decline in the mandibles capability to handle stress among representatives of *Homo* between 2.5 and 1.5 Ma. The obtained results indicate that Australopithecines and early *Homo* had stiffer mandibles probably associated with the frequent ingestion and processing of mechanically demanding food items as compared to later, modern *Homo*. The observed temporal pattern is also consistent with innovations in lithic technology and fire control. Furthermore, based on the comparison with extant primates, both hypotheses were positively confirmed, thus showing that Australopithecines probably consumed more mechanically demanding items as compared to *Homo*.

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Malaria in the rural hinterland of southern Italy: A multi-faceted anthropological and genomic perspective from Vagnari (1st-4th c. C.E.)

STEPHANIE MARCINIAK[1,3], HENDRIK N. POINAR[2,3,4] and TRACY L. PROWSE[2]

[1]Anthropology, Pennsylvania State University, [2]Anthropology, McMaster University, [3]Ancient DNA Centre, McMaster University, [4]Biology, McMaster University

Malaria in Imperial period Italy (1st-5th c. C.E.) is a paradox of a parasite given a significant role in rupturing the fabric of the Empire, but there is only a patchwork of archaeological, literary and skeletal evidence that presents challenges in identifying when and where malaria was present. By using ancient DNA to establish the causative species of malaria across contemporaneous Imperial sites in southern Italy, we unexpectedly identified a molecular signature of *Plasmodium falciparum* from a rural inland estate at Vagnari (1st-4th c. C.E.). Metagenomic screening identified 0.0029-0.0080% of all ancient molecules to Apicomplexa and *Plasmodium* in 3 of 18 adults from Vagnari, followed by RNA-based hybridization capture of human and non-human *Plasmodium* species, to successfully identify a 300-base pair read to *P. falciparum* to the exclusion of all other *Plasmodium* in a single adult male. This rural village of people living on an Imperial estate far removed from urban metropolises or other sites in the "malarial belt" presents a unique biosocial context for malaria. We highlight proxies of the intersecting relationships between humans, the *Plasmodium* parasite, *Anopheles* vector, and local ecology to explore potential malaria pathways. Of particular interest are factors related to disease ecology and the human-environment interaction, such as the drainage systems, intensified agriculture in a river valley, climatic events, timber harvesting, and increased vector contact. Although there is complexity in the transmission and spectrum of responses to malaria, we suggest a dynamic context for its presence in the rural hinterland of Roman Italy.

La donna è mobile? Lack of cyclical shifts in facial symmetry, and facial and body masculinity preferences – a hormone based study

URSZULA M. MARCINKOWSKA, ANDRZEJ GALBARCZYK and GRAZYNA JASIENSKA

Department of Environmental Health, Medical College Jagiellonian University

Although under investigation for more than two decades, a common agreement on the occurrence of cyclical shifts in women's masculinity and symmetry preferences is still missing. Such shifts are considered to be an important feature of sexual selection as they supposedly direct women's attention towards cues for "good genes" (e.g. masculinity and symmetry) during times when probability of conception is the highest. Multiple studies have, however, failed to find these shifts. We attempt to address this lack of agreement analysing a sample of 110 healthy women, using intra-participant design and repeated measurements of oestradiol and LH during the cycle. To ensure the reliable detection of increased conception probability, both LH- based ovulation tests and multiple oestradiol measurements were used. We found no significant differences between women's preferences during different cycle phases for either body or facial masculinity, or for facial symmetry. Differences remained non-significant after controlling for participants' sexual openness, relationship status, and self-judged attractiveness. We suggest that putative cyclical shifts in preferences for cues for good genes are either very small (impossible to be tracked even with a relatively large sample) or they are far more complex than previously assumed, and further studies accounting for more confounding variables should be undertaken.

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Assessing biological susceptibility to epidemic disease in mass grave contexts from Roman period Oymaağaç, Turkey

KATHRYN E. MARKLEIN

Department of Anthropology, The Ohio State University

The selectivity of epidemic disease has garnered newfound interests in recent years through the application of paleoepidemiological and (paleo)demographic theory and methods to bioarchaeological research. By evaluating differential mortality risks between individuals from pre-, circa-, and post-epidemic skeletal series, bioarchaeologists have been able to quantify biological predilections to disease and qualify the selective nature of epidemic disease within specific socioecological environments. The Roman period (2nd-4th c. CE) skeletal series from Oymaağaç, northern Turkey, provides a unique context for assessing resilience or vulnerability to epidemic disease within a genetically concordant sample. Oymaağaç remains are a composite of attritional (multigenerational) and epidemic (mass) mortality events. Adult remains from both contexts (MNI=210) were compared to evaluate biological susceptibility to epidemic disease. Biological stress markers (trauma, enamel hypoplasia, periosteal reactions, periodontal disease), which capture stress events from childhood to adult years, were scored for presence or absence. Results showed significantly lower frequency of mass grave individuals exhibiting traumatic lesions (14.7%) and LEH (9.7%) than multigenerational individuals (traumatic lesions, 37.5%; LEH, 35.5%). Although more individuals manifested PNB (16.7%) and PD (16.7%) among mass grave contexts, only PNB was significantly higher than among multigenerational individuals (2.6%) (Fisher's Exact; $p<0.05$). This analysis reveals that individuals with precursor health conditions were more susceptible to attritional mortality than mass epidemic circumstances. These results suggest that biomarkers of stress evince resilience in this population, generating additional context for the bioculturally selective nature of epidemic disease in the past and its uniquely transformative effects on specific populations.

Non-deadly violence at the Wari era site of La Real in Arequipa, Peru

HERIBERTO MARQUEZ[1], TIFFINY A. TUNG[2] and NATASHA VANG[2]

[1]Social and Behavioral Sceince, California State University, Monterey Bay, [2]Anthropology, Vanderbilt University

Skeletal remains from the site of La Real in the Department of Arequipa in southern Peru are analyzed to examine the frequency and kinds of violence experienced by this Middle Horizon (600 – 1000 CE) burial group. The mortuary evidence suggests strong ties to the Wari Empire from central, highland Peru, so we query how

those new social and political interactions structured the experience of violence for those in the southern hinterland of the Wari domain. There were two sectors at the burial site: a cave with skeletal remains that date to approximately 650 – 800 CE and an external structure with human remains that date to ca. 900 – 1050 CE. Previous research shows that approximately one-third of the adults analyzed exhibit cranial trauma. In this study, we focus on the detailed trauma analysis of complete adult crania (N=17) from the earlier dated cave.

Results:13 of the adults have at least one antemortem head wound. Among those 13, seven exhibit multiple wounds, suggesting that they were either in multiple violent events or they received multiple blows in one intense, violent interaction. The shape of the head wounds in the majority of cases was oval, suggesting that sling stones or maces were used. No projectile point injuries were observed. This analysis also investigates whether there were sex-based differences in cranial trauma and whether the presence or absence of cranial modification was correlated with higher rates of trauma. The high trauma frequency suggests that the time of Wari influence was a tumultuous period.

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The effects of forest degradation on arboreal primates within Sikundur, the Gunung Leuser Ecosystem, Northern Sumatra

CHRISTOPHER MARSH[1,2], MATT NOWAK[3], ROSS HILL[1,2] and AMANDA KORSTJENS[1,2]

[1]Ecology, Bournemouth University, [2]Landscape Ecology, and Primatology, [3]The, Sumatran Orangutan Conservation Program

The effective protection of tropical forests requires the development of methods that can rapidly assess tropical forest structure and relate this to habitat quality for keystone species, like primates. Whilst historical forest degradation's direct effect on wide-ranging mammals such as primates may be marginal in terms of reduced habitat, changes in forest structure alter the ranging behaviour and cognitive processes of primates foraging for dispersed food resources. Forest degradation also disturbs tropical forest canopy. Microclimate changes in degraded areas can drastically alter how and when primates use disturbed area of forest. Using Unmanned Aerial Systems (UASs) and microclimate data loggers, this study uses innovative, cost-effective means to collect geospatial data on tropical forest structure across a gradient of disturbance in 3-dimensions and links these measurements to the habitat requirements and travel paths of siamang (symphalangus syndactylus). This study relates over 700 hours of siamang observational and ranging data to the 3-dimensional forest structure, temperature and humidity data of 10km2 in Sikundur, Northern Sumatra. Results indicate that additional 3-D structural complexity of degraded forests and the subsequent microclimate changes directly influence travel path choice, the locations of certain behaviours and the height at which they occur.

Primate Society of Great Britain, Royal Geographical Society, International Primatological Society

Long-term declines in limb bone shaft strength among South African Bantu peoples during the 20th century

D'ARCY MARSH[1], IAN J. WALLACE[2], ERIK OTÁROLA-CASTILLO[3], VICTOR MNGOMEZULU[4] and FREDERICK E. GRINE[1,5]

[1]Anthropology, Stony Brook University, [2]Human Evolutionary Biology, Harvard University, [3]Anthropology, Purdue University, [4]Diagnostic Radiology, University of the Witwatersrand, [5]Anatomical Sciences, Stony Brook University

Incidence of osteoporosis-related skeletal fractures varies greatly worldwide. The reasons for this heterogeneity in fracture risk are unknown, but an important correlate has been hypothesized to be socioeconomic development level, with populations in highly developed countries being at greatest risk. To test the link between development status and fracture risk, we analyzed trends in limb bone shaft strength among South African Bantu peoples using cadaver-derived skeletons of adults (n=221) who died between the early and late 20th century, spanning a period of dramatic socioeconomic transformation in the country. For each skeleton, the right humerus and femur were CT-scanned, and midshaft structural properties were calculated and scaled according to body size. We found that in general linear mixed models controlling for age, sex, element (humerus vs. femur), and other factors, year of death was a significant (p=0.002) negative predictor of midshaft cortical area (a proxy for resistance to axial loading) and a nearly significant (p=0.056) negative predictor of midshaft polar moment of area (a proxy for resistance to bending and torsion). No significant interactions were detected between age and death year, suggesting that temporal declines in midshaft strength resulted from changes in skeletal maturation rather than severity of bone loss with aging. Moreover, declines in strength were similar in the femur and humerus, suggesting that shifts in systemic effects on skeletal physiology played an important role. Together, these results provide compelling support for the hypothesis that global variation in skeletal fracture risk is influenced, in part, by disparities in socioeconomic development.

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Social structure and change in West African savanna chimpanzees (*Pan troglodytes verus*) at Fongoli, Senegal

JOSHUA L. MARSHACK[1] and JILL D. PRUETZ[2]

[1]Department of Anthropology, Dickinson College, [2]Department of Anthropology, Texas State University

To clarify the processes by which social thresholds are breached and relationships re-shaped, we examine changes in male social structure in the Fongoli chimpanzee community (*Pan troglodytes verus*). We look at aggression with physical contact and corresponding changes in the linear adult male dominance hierarchy over a thirteen-month period, as well as broad multi-year patterns of injury and social change. This includes adolescent transitions into the dominance hierarchy and therefore adulthood, shifts in adult social dominance, and interactions with a peripheralized male. We conclude that injurious fights corresponding with these phenomena contrast with everyday interactions, in which contact aggression is generally rare, brief, and without substantial injury. Changes in social structure appear to require atypically intense aggression, and a liminal period behaviorally and spatially outside usual community bounds. These socio-spatial patterns may shed light on the origins of status transitions in humans.

Moreover, as well-documented in both chimpanzees and other social animals, as role certainty or familiarity decreases, the intensity of aggressive interactions increases. Therefore, the difference between severe and lethal aggression is likely one not of kind, but of degree. Likewise, separate adaptive explanations for coalitionary lethal aggression within communities during periods of marked social instability, or towards males outside the community, are not required. Thus, the role of anthropogenic effects in exacerbating conditions bears reexamination.

Morbidity Profiles Compared in Vaginally and Cesarean Born Indigenous Toba/Qom Children

MELANIE A. MARTIN[1], AMANDA VEILE[2] and CLAUDIA R. VALEGGIA[1]

[1]Anthropology, Yale University, [2]Anthropology, Purdue University

Cesarean births rates are rising in many parts of the world, often in excess of the World Health Organization recommended rate of 15%. While sometimes medically necessary and lifesaving, cesareans are evolutionarily novel and epidemiologically associated with several negative child health outcomes. However, the causes and consequences of rising cesarean rates are shaped and confounded by numerous biocultural factors that may be population-specific. These relationships must be investigated across a range of populations in order to better assess

the risks of cesarean births, particularly when medically unnecessary. We investigate the relationship between cesarean birth and early childhood morbidity in the Argentine Toba/Qom, a peri-urban indigenous population that practices universal and prolonged breastfeeding. The Toba/Qom cesarean rate is high (47%) compared to Argentina's national cesarean rate (~39%). We used a longitudinal dataset in which morbidity was tracked monthly in children aged 0-5 to compare digestive and respiratory morbidity in 49 vaginally and 33 cesarean-born Toba/Qom children (2272 observations). In mixed-effects models adjusting for child age, nutritional status, gestational age, birthweight, and comorbidities, we find that cesareans birth *per se* are not associated with greater digestive or respiratory morbidity. However, infants with postnatal complications (prematurity, hyperbilirubinemia, "other") were more than twice as likely to be cesarean-born than those with no complications. Postnatal infant complications were the strongest predictor of digestive morbidity. Children who were cesarean-born *and* had postnatal infant complications had the highest probability of respiratory morbidity.

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Assessment of the global human mandibular variation -A three-dimensional geometric morphometrics approach to the settlement of America

DIANE MARTIN-MOYA[1], MANON GALLAND[2,3] and MARTIN FRIESS[3]

[1]Département Anthropologie, Université de Montréal, [2]Departement of Anatomy, University of Pretoria, [3]Département Hommes Natures Sociétés, Muséum National d'Histoire Naturelle - UMR 7206

The first humans to have settled America went through Beringia probably from East Asia. However, the number of migration waves remains uncertain. Here we considered both mandibular and cranial variation and evaluated the impact of environmental and cultural factors on our understanding of population history. Our study is the first attempt to compare both phenetic signals based on 226 individuals from the entire American territory and Australasia and applying 3D geometric morphometric methods. Because North America has a special importance regarding the first dispersals into the New World, we have privileged North American populations from the Pacific coast including prehistoric populations: Tsimshians (Canada) and Kennewick Man (United States). Mandibular results corroborate previous observations based on the skull highlighting the particular morphology of Pericues (Baja California), Fueguians and Inuit. Tsimshians present a very high variability. Our results show a strong correlation between the cranium and the mandible shape patterns. Yet, the effects of external factors vary depending on the structure involved. Cranial variation can support the hypothesis of two major migration waves. Mandibular variation reflects a cultural and dietary influence and shed light on the high morphological variability found among Amerindian populations as well as on the complexity of the first American settlement and subsequent population history.

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Education, Social Status, and Health in Vanuatu

E. D. MASSENGILL and SIOBHAN M. MATTISON

Anthropology, University of New Mexico

It is frequently found that in developing economic contexts, increased income is associated with increased rates of obesity due to a greater consumption of market foods. Previous studies of health and market integration in Vanuatu have shown similar results. However, most of these studies have used island of residence as a gross indicator of differences in market integration and other underlying variables. In this study, we collect anthropometric and socio-economic data on individuals residing on two different islands in Vanuatu, with two different degrees of market integration. We find that it is education which predicts BMI and percent body fat, not income. We propose two possible explanations for this result: underlying social status differences are associated with both educational attainment and lifestyle; or, educated individuals are working in more sedentary occupations, regardless of income. We find evidence to support the second hypothesis, but cannot rule out the possibility that social status also plays a role.

Research was conducted with funding from the National Science Foundation and from the University of New Mexico, and with the assistance of the Vanuatu Cultural Center.

The ontogeny of sexual dimorphism among known-aged Virunga mountain gorillas (*Gorilla beringei beringei*) and Gombe chimpanzees (*Pan troglodytes schweinfurthii*)

JASON S. MASSEY[1], SHANNON MCFARLIN[2], ANTONIE MUDAKIKWA[3], TARA S. STOINSKI[4], MICHAEL R. CRANFIELD[5], TIMOTHY G. BROMAGE[6], ANNE PUSEY[7], DEUS MJUNGU[8], ANTHONY COLLINS[8] and KIERAN P. MCNULTY[1]

[1]Department of Anthropology, University of Minnesota, [2]Department of Anthropology, The George Washington University, [3]Tourism and Conservation, Rwanda Development Board, [4]Dian Fossey Gorilla Fund International, [5]Mountain Gorilla Veterinary Project, [6]Department of Biomaterials and Biomimetics, New York University College of Dentistry, [7]Department of Evolutionary Anthropology, Duke University, [8]Gombe National Park, Jane Goodall Institute

Sexual dimorphism is often used as a proxy for male competition in the fossil record and for inferring aspects of male and female socioecology. From an ontogenetic perspective, sexual dimorphism can be accomplished through two processes: altering the rate and/or duration of growth between males and females. Prior research demonstrates that evolution can act on independent modules; however, can different anatomies utilize combinations of processes to obtain dimorphism?

This study investigates the ontogeny of sexual dimorphism in known-aged specimens of Virunga mountain gorillas and Gombe chimpanzees by assessing how the sexes acquire different adult morphology from similar infant phenotypes. We used landmark-based Procrustes analysis of cross-sectional cranial data to reveal patterns of ontogeny that lead to sexually dimorphic anatomy. Ontogenetic trajectories were summarized by regressing superimposed shape variables of specific anatomical modules on dental age stages and centroid size. Differences between males and females were computed as the multivariate angle and the magnitude of the regression lines.

Results show that the acquisition of sexually dimorphic anatomy is different in *Gorilla* and *Pan*. *Gorilla* demonstrates a change in the magnitude of the growth trajectory in seven cranial modules, with the neurocranium displaying a difference in angle of growth trajectory. *Pan* obtains sexual dimorphism primarily through an alteration in the angle of growth of the upper face. These results support earlier work on the acquisition of sexual dimorphism in body sizes of captive apes, and suggest that sexual dimorphism can be obtained using a suite of processes acting differently on anatomical structures.

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Injury and Industrialization: structural violence, chronic and episodic biological stress, and trauma in working class English women

SARAH A. MATHENA-ALLEN[1], MOLLY K. ZUCKERMAN[2], ANNA J. OSTERHOLTZ[2], MICHELLE L. DAVENPORT[3], PETRA BANKS[2] and RYAN KING[2]

[1]Anthropology Department, University of Massachusetts Amherst, [2]Department of Anthropology and Middle Eastern Cultures, Mississippi State University, [3]Commonwealth Heritage Group, Inc. Milwaukee, WI.

Industrialization in the 18th and 19th century United Kingdom created a demand for an able bodied workforce, with the result of an increased mobilization of state-controlled improvements in hygiene and healthcare access, especially for working class women. However, public health and

hygiene legislation was characterized by contradictory discourses regarding the extent of the state's responsibility in caring for the body politic and social anxieties over the regulation of working class women's bodies. Historical records indicate that structural violence played a critical role in the marginalization and institutionalization of working women's bodies, creating health disparities between the socioeconomic strata, especially in rates of morbidity and mortality. However, our understanding of the direct biological outcomes for working class women's bodies from the interplay of embodied structural violence, manifesting as increased allostatic load, and public health policies and practices remains limited. Here, we begin to address this issue through analysis of skeletons estimated as female from seven post medieval cemeteries, in and outside of London, representing middling to lower and poor communities (N= 256). Taking a life-course approach, we examine relationships between oral and skeletal stress markers (e.g., LEH), non-infectious and infectious disease markers, and trauma (fractures). Preliminary results reveal high frequencies of oral pathologies across all assemblages (24.9-88%), but higher frequencies of traumatic lesions (30.3%) and increased mortality rate for reproductive age females at Coronation Street than other sites, indicating public health measures were uneven across the U.K., with working class women outside London at slightly higher risk for increased allostatic load.

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Kinship mediates the relationship between market integration and social inequality in the Mosuo of Southwest China

SIOBHAN M. MATTISON[1], CHUN-YI SUM[1], ADAM Z. REYNOLDS[1], TAMI BLUMENFIELD[2] and MARY K. SHENK[3]

[1]Anthropology, University of New Mexico, [2]Asian Studies, Furman University, [3]Anthropology, Penn State University

Social inequality is typically exacerbated by increased access to defensible material wealth. This suggests the hypothesis that market integration, which creates novel opportunities in cash economies, is associated with increasing inequality. Using demographic data collected from 505 households among the matrilineal and patrilineal Mosuo in 2017, we test this hypothesis and ask whether kinship system (matrilineal versus patrilineal) mediates the relationship between market integration and inequality. Our data reveal only weak support for this hypothesis: there is a Kuznets relationship between market integration and inequality in patrilineal communities, where increasing emphasis on the market (proxied by mean household income) shows an inverted U-shaped relationship with inequality; in matrilineal communities, the relationship is negative. We explore several possible mechanisms (e.g., household size, dependency ratio) leading to these differences to explain why matriliny and patriliny might mediate the relationship between market integration and inequality. We conclude that broader social networks and normative pressure to share resources in matrilineal communities may provide greater buffers against rising inequality than in patrilineal communities.

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Bone Histology Age-at-Death Estimates and Associated Taphonomic Changes at St. George's Caye, Belize

SOPHIA R. MAVROUDAS[1] and LAUREN C. SPRINGS[2]

[1]Anthropology, Texas State University, [2]Anthropology, University of Texas at Austin

This project analyzed femoral histological samples from 10 individuals uncovered from St. George's Caye in Belize. The site of St. George's Caye is an 18th century historical cemetery that is the oldest non-Maya cemetery in Belize. The individuals for this project were excavated between the 2011 and 2012 field seasons. The aim of the research was first to examine the utility of histological age-at-death estimation on this sample by comparing the histological age estimates to gross morphology age estimates and second to examine the effect of various taphonomic factors on the bone histology. Overall, histological analysis of the femur was able to narrow the final age estimate for 60% percent of all samples and 100% percent of well-preserved samples. When taphonomic alterations were examined, degenerative changes were linked to specific burial contexts. When present, periosteal diagenesis (caused by sun-bleaching, staining of the bone from decaying material such as roots and coffin wood, and mold intrusion) resulted in grossly overestimated histological ages. This has great implications for future study of 18th century skeletal populations of Belize and the Caribbean. Due to the highly fragmentary nature of much of the skeletal remains from this time period, gross morphology indicators are not always available for analysis. Future archaeological discoveries that include skeletal remains of femora can now be analyzed for age using bone histology techniques provided there is good preservation and no periosteal diagenesis present. This can allow for a more thorough understanding of the demography of historic Caribbean populations.

Sporadic sampling not climatic forcing drives early hominin diversity

SIMON J. MAXWELL[1,2], PHILIP J. HOPLEY[1,2], PAUL UPCHURCH[2] and CHRISTOPHE SOLIGO[3]

[1]Department of Earth and Planetary Sciences, Birkbeck, University of London, [2]Department of Earth Sciences, University College London, [3]Department of Anthropology, University College London

The role of climate in the origin and diversification of early hominins is hotly debated. Much of this debate has centred on whether change in the early hominin fossil record is continuous or pulsed, and whether diversification is causally linked to directional shifts in climate or periods of intense climatic instability. Yet, in all previous studies, fluctuations in the number of hominin taxa are accepted as genuine changes in diversity, even though it is possible that such fluctuations reflect changes in the quality of their fossil record. We present a detailed examination of early hominin diversity dynamics through time, including both taxic and phylogenetically corrected diversity estimates. We also compare these estimates to sampling metrics for rock availability (hominin-, primate-, and mammal-bearing formations) and collection effort, in order to assess the geological and anthropogenic controls on the sampling of the early hominin fossil record. Taxic diversity, primate-bearing formations, and collection effort show strong positive correlations, raising the possibility that some features of hominin diversity may, in fact, represent sampling mega-biases rather than a genuine evolutionary signal. Peak diversity at 1.8 Ma is a sampling artefact, reflecting merely maximal rock availability and collection effort. Phylogenetic diversity estimates imply peak diversity at 2.4 Ma, shortly after the origin of *Paranthropus* and *Homo*, and show little relation to sampling. We find no evidence of pulsed turnover in the early hominin fossil record or any link to climate proxies and, instead, argue that the appearance of pulsed change is an artefact of uneven sampling.

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Analyzing immigration in historic America through $^{87}Sr/^{86}Sr$ isotopic analysis of the remains interred in the Erie County Poorhouse Cemetery 1851-1913

MELANIE M. MAYBERRY[1,2] and JOYCE E. SIRIANNI[1]

[1]Anthropology, University at Buffalo, [2]Anthropology, SUNY Buffalo State

Strontium isotope analysis of human remains provides insight into individuals' lives, specifically related to settlement, migration, and, historically, immigration. The remains excavated from the Erie County Poorhouse Cemetery in Buffalo, New York yielded 392 unidentified individuals in 2012. The individuals interred in the Erie County Poorhouse Cemetery from 1851-1913 are thought to have been primarily immigrants from various regions. Previous ancestry research classified a number of these individuals as having belonged to European, Asian, and African ancestral groups. However, ancestry data could not take into account individuals' nativity. Examining

possible regions of origin for these same individuals has shed light on not only the composition of historic Buffalo but also the plight of the historic American immigrant in 19th century working-class American cities. Strontium isotope analysis allows researchers to understand an individual's provenance through geological processes associated with each global region. Determining specific regional associations with strontium analysis is difficult in populations of significant diversity such as with the Erie County Poorhouse Cemetery, so this study utilized both enamel and dentin strontium signatures to assess childhood and adult levels, respectively. With these data, individuals were classified as Western New York natives or immigrants. In analysis of 20 individuals, both Buffalo-born and immigrant individuals were determined based on the $^{87}Sr/^{86}Sr$ isotope data, with roughly 60% of individuals resulting in $^{87}Sr/^{86}Sr$ signatures of non-native Western New Yorkers. When comparing enamel and dentin signatures, more than 40% of individuals appear to have relocated throughout their lives.

Age-Associated Changes in Subadult Cross-Sectional Geometry of Ribs: A Comparison Between Modern and Medieval Polish Samples

REBECCA C. MAYUS and AMANDA M. AGNEW

Department of Anthropology, Skeletal Biology Research Laboratory, The Ohio State University

Skeletal growth in human ribs is a complex process largely characterized by bone modeling and resulting cortical drift with thoracic expansion. Cross-sectional geometry provides quantitative data reflecting alterations in bone size and shape to meet biomechanical demands. The objective of this study was to identify differences between a modern and an archaeological sample in the relationship between cross-sectional geometric variables and age. Total subperiosteal area, cortical area, and relative cortical area were calculated from histologically prepared cross-sections taken at mid-shaft from mid-level ribs of two skeletal samples. The first was a modern pediatric sample and the other was a medieval (11th – 12th c.) Polish sample (Giecz Collection; site Gz4) with ages at death for both ranging from infancy (<1 year) to approximate skeletal maturity (20 years). In the modern sample, cortical area and total area increased at similar rates, resulting in a trend of fairly constant relative cortical area across all ages. These results were mirrored in the medieval ribs; though total area tended to increase at a slower rate than in the modern sample, relative cortical area did not have a relationship with age. Both modern and medieval subadults appear to have exhibited comparable responses to environmental conditions prior to death, resulting in similar cross-sectional geometry in ribs. The observed maintenance of relative cortical area may reflect biomechanical demands on ribs during periods of stress or declining health, specifically the optimization of bone quantity to combat deteriorating metabolic conditions, since subjects in both samples died before reaching maturity.

Great Hungarian Plain Diet and Mobility through the Neolithic, Copper Age, Bronze Age, and Iron Age

ASHLEY MCCALL

Archaeology, University College Dublin

The progression from hunting and gathering to farming, known as the 'Neolithic revolution', is characterised as one of the most noteworthy cultural changes in European prehistory. This change may have occurred through the cultural transmission of new technologies and subsistence strategies from neighbouring groups and population movements. The Great Hungarian Plain (GHP), occupying part of Hungary and parts of five surrounding countries, was a passage for cultural admixture and population influx via the Eastern Steppe corridor. This area is seen as a hub of cultural change where settlement patterns shifted during both the Neolithic and Copper Age and again during the Bronze and Iron Ages. What were the social and technological transformations from the Neolithic through the Iron Age? This project uses stable isotope analyses to answer this question and examine how changes in this area evolved over the course of about six thousand years. This type of analysis will provide evidence for subsistence strategies and their possible shifts through time. Additionally, this approach also provides data on possible cultural influence regions due to migration. This project increases the data available on mobility, diet, and socio-economic changes that occurred during these four time periods. The isotopic data also help elucidate the potential cultural dispersal patterns and the rate at which these may have occurred. Finally, the isotopic data help clarify potential cultural evolution patterns in the region and the rate at which these would have occurred.

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Spatial packing constraints on cranial form in howler monkeys (genus *Alouatta*)

ROBERT C. MCCARTHY[1], JEREMY NADOLSKI[2], ANTHONY DELEGGE[2] and THEODORE M. COLE III[3]

[1]Department of Biological Sciences, Benedictine University, [2]Department of Mathematical and Computational Sciences, Benedictine University, [3]Department of Basic Medical Science, University of Missouri - Kansas City

The "spatial packing hypothesis" predicts that flexion of the primate cranial base is related to the need to fit the brain into a space limited by basicranial length. Biegert (1963) hypothesized that airorhynchy (dorsal rotation of the face) and retroflexion (flexion >180°) are caused by the close approximation of pharyngeal structures like air sacs and ossified hyoid bullae to the external basicranium.

To test these hypotheses, we collected bulla volume (BV), endocranial volume (ECV), and cranial landmark coordinates from 162 adult and 30 juvenile specimens belonging to 12 howler monkey species, calculated cranial base, orbital, and palatal angles, and created measures of relative brain and bulla size by dividing ECV and BV by basicranial lengths. We used correlation, partial correlation, and reduced major axis ANCOVA analyses to test hypotheses about the relationship between ECV, BV, basicranial length, and craniofacial flexion.

Hyoid bulla volume scales with positive allometry relative to cranial size, and palatal angles are greater in males, particularly *A. seniculus*-group males with large hyoid bullae. Bulla volume correlates only with palate orientation, whereas ECV is not correlated with any measure of craniofacial orientation. Limited data from juveniles hint that palatal airorhynchy increases during ontogeny. Together, these results suggest that hyoid bulla size affects palate orientation at ontogenetic, intra- and interspecific levels in *Alouatta*, but has no effect on orbit orientation or retroflexion of the cranial base. Retroflexion and airorhynchy in *Alouatta* are likely the result of spatial packing pressures working on opposite sides of the basicranium.

Plastic and evolved responses to locomotor behavior in the morphology of the cranium

FAYE MCGECHIE[1], KRISTINA ALDRIDGE[1], SCOTT A. KELLY[2], THEODORE GARLAND[3] and KEVIN M. MIDDLETON[1]

[1]Pathology and Anatomical Sciences, University of Missouri School of Medicine, [2]Zoology, Ohio Wesleyan University, [3]Biology, University of California Riverside

Previous research has associated features of the mammalian cranium with postural and locomotor adaptation. Here, we investigate the response of the cranium to locomotor change using a mouse model. We designed an experiment with balanced groups separated by control mice (C) and mice bred for voluntarily running long distances (HR). Each of these groups was further divided into mice with access to an exercise wheel and mice without wheel access. We test the hypothesis that changes in postural and locomotor behavior produce variation in cranial morphology at the plastic and adaptive levels.

3D coordinates were collected from MicroCT scans for 37 cranial landmarks using Checkpoint© (N=38 adult female mice). Specific features influencing overall cranial morphological variation and localized statistically significant

differences among groups were identified using Euclidean Distance Matrix Analysis (EDMA).

Results demonstrate the C and HR lines have distinct cranial morphology. HR mice demonstrate an expanded braincase, reduced facial prognathism, ventral rotation of the face, and increased foramen magnum size. Access to an exercise wheel has minimal effects on overall cranial morphology in both mouse lines. However, there are significant localized changes in response to wheel access, but these changes differ in the two lines.

This study is among the first to experimentally test the relationship between head orientation, locomotion, and cranial form in a controlled setting. Our findings support the use of key morphological features to examine postural adaptation in both extant and extinct mammals and bolster the evolutionary significance of the relationship between morphology and locomotor adaptation.

Histological correlates of LEH expression in great apes

KATE MCGRATH[1], DEBBIE GUATELLI-STEINBERG[2], SIREEN EL ZAATARI[3], KEELY ARBENZ-SMITH[1], DONALD J. REID[1], MICHAEL R. CRANFIELD[4], TARA S. STOINSKI[5], TIMOTHY G. BROMAGE[6], ANTOINE MUDAKIKWA[7] and SHANNON C. MCFARLIN[1,8]

[1]Center for the Advanced Study of Human Paleobiology, Anthropology, George Washington University, [2]Anthropology, Ohio State University, [3]Paleoanthropology, Senckenberg Center for Human Evolution and Paleoenvironment, Universität Tübingen, [4]Mountain Gorilla Veterinary Project, [5]Dian Fossey Gorilla Fund International, [6]Biomaterials and Biomimetics, New York University College of Dentistry, [7]Tourism and Conservation, Rwanda Development Board, [8]Division of Mammals, National Museum of Natural History, Smithsonian Institution

Developmental defects in teeth are understood to reflect the stress experiences of primates. Commonly-studied defects termed linear enamel hypoplasia (LEH) appear as pronounced grooves on the outer enamel surface, and are associated with periods of malnutrition, injury, and/or illness in modern humans. We recently showed that LEH defects are more common in mountain gorillas than previously recognized, but are significantly shallower than in other apes ($p<0.001$). While shallow defects are assumed to reflect reduced stress severity, geometric aspects of enamel growth may also influence defect morphology. In canine histologic sections of four great ape taxa (*Gorilla beringei beringei*, *G. gorilla gorilla*, *Pan troglodytes*, and *Pongo* sp.; N=16) we measured the angle with which enamel growth increments approach the outer tooth surface and other enamel crown growth parameters. We found that mountain gorillas have significantly shallower striae angles than other apes (ANOVA, $p=0.027$), which may reflect faster enamel extension rates and contribute to shallow defects. Accentuated lines (AL), microscopic defects visible in the internal enamel structure, co-occurred at the onset of each LEH defect observed in our sample (N=99). However, each thin section was found to have more AL than LEH defects. Histologic analyses allow for detailed reconstructions of the response to stress episodes, and a deeper understanding of the microstructural formation of LEH. By incorporating available life history records available for individual mountain gorillas, it is possible to assess the type and duration of stress events that disrupted growth.

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Field perspectives on primate locomotion and functional morphology: tales from the Tai Forest

W. SCOTT. MCGRAW[1], NOAH T. DUNHAM[2], ERIN E. KANE[3], RICHARD PAACHO[5], TAYLOR A. POLVADORE[4] and DAVID J. DAEGLING[4]

[1]Anthropology, The Ohio State University, [2]Anatomy and Neurobiology, Northeast Ohio Medical University, [3]Anthropology, Boston University, [4]Anthropology, University of Florida, [5]Zoology, Centre Suisse de Recherche Scientifique

Stern & Oxnard's (1973) influential monograph on primate positional behavior and morphology helped establish the theoretical foundation for decades of research, including captive work at the Stony Brook locomotion laboratory (SBLL). Although it foreshadowed many ideas explored in that lab over the next 40 years, the 1973 paper focused largely on the importance of field studies, emphasizing that functional interpretations of structure were possible only when based on observation made in the wild. Since then, advances in laboratory techniques have outpaced innovations in field methodology, but field studies remain critical for interpreting laboratory research. Here we present results from a series of "natural experiments" on a cercopithecid community in the Ivory Coast's Tai Forest conceived, in part, as expansion of work at the SBLL. Standard observational and video-based sampling techniques were used to quantify elements of positional behavior and limb anatomy in three colobine and four cercopithecine taxa. These data are used to explore: (1) relationships among leaping, climbing, limb metrics and body size, (2) covariation of forelimb anatomy with patterns of forelimb elevation in *Piliocolobus badius*, *Cercopithecus diana*, and *Cercocebus atys*, (3) associations between bounding and limb morphology in *Colobus polykomos*, (4) how forelimb and shoulder anatomy is understood via foraging idiosyncrasies in *C. atys*, (5) semi-brachiation and shoulder morphology of *P. badius*, and, (6) association of hindlimb features with vertical climbing in *C. atys*. The impetus for these inquiries derives from many sources, but in each case results are interpretable due to research conducted first at the SBLL.

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Taking another bite at the apple: a comparative analysis of incisor form and food mechanical properties in haplorrhine primates

AMANDA MCGROSKY and GARY T. SCHWARTZ

Institute of Human Origins, School of Human Evolution and Social Change, Arizona State University

Primate dental morphology is hypothesized to be subject to selective pressures related to feeding. Various hypotheses link incisor morphology to diet and feeding behavior, but one that has received significant attention proposes that mesiodistally elongate incisors are adaptations to frugivory. Subsequent work revealed that this relationship may not be as straightforward as originally proposed, and that food mechanical properties (FMPs) exert selective pressures on dental form. Using modern comparative phylogenetic analyses, we test whether FMPs better explain variation in mesiodistal incisor length (MDL) than do traditional diet categories and hypothesize that longer incisor rows will be associated with the consumption of less elastic and less tough foods.

Mean mesiodistal maxillary incisor lengths, dietary information, and FMP data for 81 haplorhine species were gathered from the literature and from CT scan archives. Phylogenetic ANOVAs testing the association between dietary categories and body mass-controlled I^1, I^2, and incisor row MDL were nonsignificant ($p>0.05$). PGLS regressions of the same three incisor metrics on two FMPs, toughness and elasticity, were also nonsignificant ($p>0.05$). These results corroborate conclusions that mesiodistally elongate incisors are not strictly associated with frugivory. They also suggest that incisor row dimensions are not subject to selective pressures imposed by food toughness or elasticity. Primate incisors participate in a diversity of feeding behaviors, and other aspects of incisor morphology (e.g., incisal curvature) or the bite forces that can be generated across incisor rows of different lengths may be more closely linked to the mechanical demands imposed by FMPs.

Acute salivary steroid hormone responses in juvenile boys and girls to non-physical team competition

TIMOTHY S. MCHALE[1], PETER B. GRAY[1], KA-CHUN CHAN[2], DAVID T. ZAVA[3] and WAI-CHI CHEE[4]

[1]Anthropology, University of Nevada, Las Vegas, [2]Psychology, University of Hong Kong, [3]Research, ZRT Laboratory, [4]Department of Education Studies, Hong Kong Baptist University

Little psychoneuroendocrine research has focused on steroid hormone responses to non-physical competition during middle childhood. This study investigated acute salivary steroid hormone responses among Hong Kongese children (*N* = 45), aged 9-10 years, during a team, mixed-sex, math competition. We compared boys' and girls' competition induced hormone changes and explored whether psychosocial variables, such as participation, class team rank, and performance measures moderated hypothalamic-pituitary-adrenal (HPA) axis activity while controlling for age, Body Mass Index, and pubertal development. Simultaneous measures of testosterone, estradiol, dehydroepiandrosterone (DHEA), androstenedione and cortisol were collected among ethnically Chinese boys (*n* = 18) and girls (*n* = 27). Testosterone and estradiol levels were generally low and unmeasurable. Similar patterned hormone changes were observed among both sexes despite girls possessing higher levels of androstenedione. Nearly every competitor experienced decreases in cortisol and cortisol/DHEA ratio. DHEA and androstenedione did not significantly change during the competition among the total sample. A significant association was observed between DHEA change and class team rank, indicating that competitors from teams who performed worse tended to experience larger decreases. Among active competitors, performance measures (e.g. number of correct responses) predicted DHEA change and androstenedione change, but not cortisol change, suggesting that DHEA and androstenedione are sensitive to psychosocial variables relevant to competition. Cortisol ratio change was positively correlated with age. These data provide new insight into HPA axis activity during social competition among juveniles, life history approaches to adrenarche, while highlighting participation and performance measures that are worthy of methodological consideration for future research.

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Facial soft tissue depth in mid-sagittal plane: its growth patterns and individual variation from childhood to adulthood

MEGHAN R. MCKINNON[1], ELLIE K. SIMPSON[2] and MACIEJ HENNEBERG[1]

[1]Anatomy & Pathology, The University of Adelaide, [2]Forensic Anthropology, Forensic Science SA

Dimensions of bony structures and soft tissue overlying the face largely contribute to outward facial morphology. Previous studies have used longitudinal samples to investigate growth and variation of the skeletal aspects of the face, far less has been done on the soft tissue. Using a longitudinal sample we investigate co-variation of bony and soft tissue dimensions from childhood to adulthood. This study used a longitudinal sample of white Americans (n=60) from the Denver Growth Series and Fels Longitudinal Growth Study, whereby each individual provided annual lateral cephalometric radiographs between 1 month and 19 years. A total of 1036 radiographs were digitized, and distances between facial landmarks were measured using ImageJ.

All bony dimensions showed substantial increase with age, whereas soft tissues showed little to no change. Two-way Analysis of Variance (ANOVA) showed all landmark distances were significantly different (P>0.05) between age groups, and most were significantly different between sexes. Effect size analysis (η^2, ANOVA) showed age explained a much greater percentage of facial variability than sex. Unlike bony dimensions, most soft tissue changes between 0 to 19 years of age are small (<3mm), not correlated to underlying facial skeleton dimensions, and of little practical value. The exception to this is the thickness of the upper and lower lips which increased substantially with age, (>5mm). This can have potential applications in forensic facial reconstructions.

The Evolution of Lifespan and the Epigenome Assessed by CpG Frequency in Conserved Primate Promoters

ADAM T. MCLAIN[1] and CHRISTOPHER FAULK[2]

[1]Department of Biology and Chemistry, College of Arts and Sciences, SUNY Polytechnic Institute, Utica, NY, [2]Department of Animal Sciences, College of Food, Agricultural, and Natural Resource Sciences, University of Minnesota, St. Paul, MN

CpG dinucleotides are estimated to mutate 10 to 50 times faster than non-CpG sites within vertebrate genomes, resulting in evolutionary and fitness consequences. Here we computationally analyzed the genomes of 28 primate species (genera examined were *Aotus*, *Callithrix*, *Carlito*, *Cebus*, *Cercocebus*, *Chlorocebus*, *Colobus*, *Daubentonia*, *Eulemur*, *Gorilla*, *Homo*, *Macaca*, *Mandrillus*, *Microcebus*, *Nasalis*, *Nomascus*, *Otolemur*, *Pan*, *Papio*, *Pongo*, *Propithecus*, *Rhinopithecus*, and *Saimiri*) within highly conserved promoter regions for the presence of CpG density correlated with a quantifiable trait. An initial database of 25,503 promoter regions from the human genome was obtained from the Eukaryotic Promoter Database and used as the basis for constructing a database of conserved promoters across primate genomes. Lifespan data obtained from the AnAge database was used as the quantifiable trait. Briefly, we found that 987 (3.8%) of conserved promoter regions in primates showed a significant correlation between CpG density and lifespan and 94% of these displayed a positive correlation. Our results suggest that the most rapidly mutating sites within the genome, CpG sites outside of coding regions, are strongly and positively associated with life history traits. The list of genes identified through our method should be priority targets for epigenetic assessment or modification as it affects the correlated trait.

A two-dimensional micro-tomographic study of taurodontism in the Atapuerca-Sima de los Huesos lower molars

CATHERINE MCLEAN[1], MARÍA MARTINÓN-TORRES[1,2], LAURA MARTÍN-FRANCÉS[3,4], JUAN LUIS ARSUAGA[5] and JOSÉ MARÍA BERMÚDEZ DE CASTRO[1,3]

[1]Department of Anthropology, University College London, [2]Ciencias Históricas y Geografía, Universidad de Burgos Facultad de Humanidades y Educación, [3]Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Paseo de la Sierra de Atapuerca 3, [4]Laboratoire PACEA, UMR 5199, Université de Bordeaux, [5]Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, Avd. Monforte de Lemos 5, Pabellón 14, 28029 Madrid, Spain

The morphological study of the Middle Pleistocene hominins discovered at Sima de los Huesos (Sierra de Atapuerca, Spain) suggest that they are closely related to Neanderthals. Although the Sima de los Huesos (SH) dentition has been extensively studied, no in depth analysis of taurodontism has been done to date. This study aims to establish protocols to measure taurodontism on micro-CT images in order to characterize the SH mandibular molars and explore their affinities with Neanderthals and modern *Homo sapiens*.

A total of 60 first and second permanent mandibular molars were selected from three populations including modern *Homo sapiens*, Neanderthals, and the SH hominins. We established a plane for the maximum measurement of the pulp cavity and used the measurements of Taurodont Index, Height of Bifurcation Index, and total length of root to characterize and compare the molars using statistical analyses.

All of the SH molars analyzed in this study expressed some degree of taurodontism. For most of the measurements compared, there were no significant differences between SH and Neanderthal molars, and significant differences were found between *Homo sapiens* and the other two groups.

Overall, the SH molar roots showed more similarities to Neanderthals than to *Homo sapiens* in this study, which is consistent with previous analyses of the SH morphology. The similarities regarding SH and Neanderthals further supports the view that the SH hominins have a close phylogenetic relationship to Neanderthals and that Neanderthal morphology has deep roots in the European Middle Pleistocene.

New techniques for the quantitative analysis of locomotor kinematics in free-ranging primates

ALLISON MCNAMARA[1], NOAH T. DUNHAM[2], LIZA SHAPIRO[1] and JESSE W. YOUNG[2]

[1]Anthropology, University of Texas at Austin, [2]Anatomy and Neurobiology, Northeast Ohio Medical University

Laboratory studies yield important insights into primate locomotor biomechanics, functional morphology, and performance, but fail to capture the range of ecological and structural variation encountered by primates moving in their natural habitats. We present techniques for collecting kinematic data in primates' natural habitats using consumer grade high-speed cameras, and we demonstrate novel methods for quantifying arboreal substrate characteristics. We first piloted these methods on free-ranging squirrels and arboreal substrates in Ohio and Texas. We then collected video data of nine platyrrhine species and quantified substrate characteristics at the Tiputini Biodiversity Station in Ecuador. Modified GoPro Hero5 cameras equipped with varifocal zoom lenses provided high-resolution footage (1080p; 120 fps) at distances up to 50+ m. Gait digitization and analyses were conducted in our open-source MATLAB software, GaitKeeper. We used a TruPulse 360R rangefinder to quantify branch height (accuracy: ± 30 cm) and inclination angle relative to gravity. Inclination angles calculated using the rangefinder were comparable to those recorded with a digital inclinometer (mean error: 2.5º). Branch diameter was measured remotely using photogrammetric and parallel laser methods, which were then compared to digital caliper measurements. Both methods provided accurate estimations (mean error: 1.5 – 2.0 mm; percent error: 3.1 - 4.5%). Branch compliance (mN^{-1}) was quantified by recording the force required to displace branches to known distances along a rope. Ultimately, these methods will help identify how primate gait kinematics respond to substrate variation in a complex arboreal habitat, furthering our understanding of the adaptive context in which primate quadrupedalism evolved.

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First fossil ape specimen from the early Miocene locality Magare, Kenya

KIERAN P. MCNULTY[1], THOMAS LEHMANN[2], RUTGER J. W. JANSMA[1] and SAMUEL N. MUTETI[1]

[1]Anthropology, University of Minnesota, [2]Messel Research and Mammalogy Department, Senckenberg Research Institute and Natural History Museum

Early Miocene paleontology of the Kisingiri volcanic complex has primarily focused on Rusinga and Mfangano Islands. Other fossiliferous outcrops in the area are poorly studied – due to the scarcity of fossil primates – but have the potential to inform debates about the geographic, temporal, and ecological ranges inhabited by early Miocene species. One such locality, Magare, is known from a modest sample of fossils and thought to be stratigraphically equivalent to Rusinga's Hiwegi Formation. The detailed geology of Magare has not yet been documented, but strata in the area are comprised primarily of volcanic debris from Kisingiri.

Results of a survey in 2017 include new fossil specimens found at several exposures: rare aquatic taxa; a few mammals, probably more adapted to open environments; and, trace fossils indicative of paleosols. The new collection also includes an edentulous anthropoid mandible fragment preserving the left corpus from I_2 to M_1. A definitive identification is impossible from this fragment alone, but contours of the corpus bear a strong resemblance to KNM-RU 1855, attributed to *Nyanzapithecus vancouveringorum*, and clearly differentiate it from mandibles of other Rusinga species. This specimen is the first primate known from Magare, and the only undoubted catarrhine from the Uyoma peninsula, thereby extending the range of catarrhines in this area. More importantly, the presence of *N. vancouveringorum* in Magare – when it is rare on Rusinga – might present a new opportunity to learn about this enigmatic species and contrast its ecological preferences with those of *Ekembo*.

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Geometric Morphometric Analysis of the Hominin Calcaneus

ELLISON J. MCNUTT[1,2] and JEREMY M. DESILVA[1]

[1]Anthropology, Dartmouth College, [2]Ecology, Evolution, Ecosystems, and Society, Dartmouth College

The anatomy of the human calcaneus is well-adapted for obligate, striding bipedal locomotion. However, the evolutionary history of the calcaneus remains unclear due to the rarity of this element in the hominin fossil record and the high frequency of preservation issues within those recovered. This study uses geometric morphometrics to examine shape differences between fossil hominin, human, and extant ape calcanei to test the hypothesis that calcaneal form corresponds to different locomotor strategies. This study included comparative material from *Homo sapiens* (n=32, including 4 small-bodied individuals) and extant apes (n=30), as well as casts from five hominin species: *Australopithecus afarensis* (A.L. 333-8,-55), *Australopithecus africanus* (StW 352), *Australopithecus sediba* (U.W. 88-99), *Homo naledi* (U.W. 88-1322), and early *Homo* sp. (Omo-33-74-896). GM results cluster the *A. afarensis* calcaneus with those of modern humans. *A. sediba* falls within in the morphospace between *H. sapiens* and *G. gorilla*. More limited analysis (due to damage) of StW 352 and the Omo calcaneus found that StW 352 is within the range of modern humans while the Omo calcaneus clusters near gorillas. The unusual position of the Omo calcaneus raises questions about its attribution to *Homo*. The clustering of the Hadar calcanei with modern humans supports previous interpretations of *A. afarensis* as possessing a surprisingly human-like calcaneus at ~3 Ma. Lastly, taken together the GM analysis of the calcaneus shows that *A. sediba* occupies a unique morphospace compared to the extant great apes and other Plio-Pleistocene hominins, possibly reflective of this species increased reliance on arboreality.

Reevaluating the Relationship between Anemia and Cranial Porosities in a 13th Century Ancestral Puebloan Population

CAIT B. MCPHERSON

Anthropology, University of Arizona

Anemia, a physiological condition resulting from an inadequate or ineffective supply of erythrocytes, is a major global health problem affecting approximately 27% of the world's population and 43% of all children under 5 years of age. Traditionally, bioarchaeologists have assessed general population health by evaluating the prevalence and severity of two biomarkers thought to result from cranial bone marrow (CBM) expansion secondary to anemia: cribra orbitalia (CO) and porotic hyperostosis (PH). The etiologies of these biomarkers remain poorly understood, and current scoring standards produce high rates of interobserver error. The goal of this study is to develop an interpretive framework for evaluating CO and PH which: 1) integrates recent clinical studies on CBM development throughout the lifespan, and 2) better accounts for locally-specific dietary and environmental factors which influence anemic etiologies. As a test case, the presence and severity of CO and PH were assessed using the Global History of Health Project standards for 263 individuals from Turkey Creek Pueblo, a 13th century Ancestral Puebloan settlement. Sex and age were assessed using standards developed by Buikstra and Ubelaker (1994). Low overall rates of CO and PH (13.5%/39.9%) indicate the population enjoyed good general health. Varied rates and severity scores of CO and PH across age cohorts suggest that changes in cranial bone marrow (CBM) throughout the lifespan impact the development of cranial porosities. Accordingly, it is recommended that scoring standards should be revised to account for age-related changes to CBM content and diploë volume.

Regional variations in predominant collagen fiber orientation in the diaphysis and neck of sub-adult baboon femora resemble those in adult chimpanzee femora. Does this reflect similar load histories?

CHAD S. MEARS, KENDRA E. KEENAN and JOHN G. SKEDROS

Orthopaedic Surgery, University of Utah

Studies of how microstructural/nanostructural and gross structural characteristics might functionally adapt a bone have show that predominant collagen fiber orientation (CFO) is the strongest correlate of a bone's load history, regardless of whether it is habitual torsion or bending. But these data were obtained mostly in adult bones. To better establish the use of CFO data for interpreting strain history, we studied femora from sub-adult baboons (*Papio cynocephalus anubis*; ages 3-4 years, n=5). Sections were cut transversely at mid-diaphysis (presumably mostly a torsion region), upper diaphysis (presumably bending>torsion), and femoral neck (presumably bending>torsion). Circularly polarized images obtained in octants were examined for predominant CFO, which was inferred from mean gray levels (birefringence differences) where: (1) brighter gray levels represent oblique-to-transverse CFO, which adapts bone for compression, and (2)darker gray levels represent more longitudinal CFO, which adapts for tension. Baboon CFO data were compared to our reported results in adult chimpanzee femora. Results showed that the baboon femora had approximately the same regional differences shown previously in adult chimpanzees. Specifically, the baboon femoral neck had more oblique-to-transverse CFO in the posterior-superior, superior, anterior-superior, and anterior cortices when compared to combined data of the other four cortices (p=0.001). Similar to chimpanzees, the baboon femora also had: (1) expected CFO differences between medial(compression) and lateral(tension) cortices for habitual bending across the upper diaphysis, and (2) the mid-diaphysis showed no regional CFO differences, as expected in habitual torsion. These results suggest that regional CFO variations can be useful for interpreting load history in sub-adult bones.

Differences in Obstetric Care Experiences Across Demographic Groups in Alabama

KAYLEIGH A. MEIGHAN

Department of Anthropology, The University of Alabama

According to the Centers for Disease Control, Alabama had the United States' worst infant mortality rate (IMR) in 2014. In 2015, the IMR for white residents was 5.2%, but among black and other residents it was 14.4% in Alabama. The goal of this project is to provide geographical data and case studies to better understand the implications of Alabama's IMR and to address factors in the overall gap in treatment between demographic groups. This project includes geographical analyses using rates of infant mortality by county, location of hospitals with and without obstetric centers, distribution of midwifery services, rural and low income communities across Alabama, and demographics including race. Data suggest the IMR tends to be highest in rural counties, and especially those with fewer hospitals in the region. Additionally, those counties with more demographic minorities tend to have a higher IMR than those that do not, and tend to be farther from hospitals with obstetric centers. Case studies of birth experiences from low-income minority women in rural areas were compared to case studies of higher income women from urban and suburban areas. Obstetric care experience satisfaction for rural-dwelling low-income minority women was lower than urban- and suburban-dwelling high-income women. These narratives, when combined with geographical analyses, elucidate treatment gaps in underserved populations that inform where improvement can be made in Alabama's obstetric care.

Weed Macaques provide insight into the demographic success of early hominids

RICHARD S. MEINDL, MORGAN E. CHANEY and OWEN LOVEJOY

Anthropology, Kent State University

Hominids (*Australopithecus* and *Homo*) and *Macaca* have proved unusually successful demographically in the Plio-Pleistocene. Current evidence suggests that these two clades greatly expanded their geographic ranges beginning around 3.5 MYA (hominids) and 7 MYA (macaques). Today macaques enjoy broad taxonomic success as well, with some 20 living species that resulted from three major radiations. A detailed examination of their vital rates is therefore instructive.

Richard et al. (1989, *Inter. J. Primatology*, 10(6):569-594) have designated four macaques as "weed species," owing to their preference for riverine secondary forests that emerged across tropical Asia during thousands of years of human disturbances including swidden agriculture. Secondary forests were likely primary niches for *Australopithecus* as well, and we separate the mortality and fertility functions of the weed species to show that they can serve as models for Pliocene radiations.

Female macaque fertility is more resistant to the environment than many have come to believe. The success of these monkeys is instead due to a lessening of pre-reproductive mortality, which propels a larger proportion of the female birth cohort into the reproductive years, resulting in episodes of extremely high population growth. This demographic aspect of the relatively r-selected cercopithecoid monkeys was fundamental to their success in the Neogene and offers a new understanding of early hominid demography as well as a stark contrast to ape demographic profiles.

Color vision and the ecology of nocturnal mammals: insights from leaf-nosed bats (Phyllostomidae) and primates

AMANDA D. MELIN[1,2], KELLY KRIES[3], MARÍLIA A.S. BARROS[4], GWEN DUYTSCHAEVER[1], JOSEPH D. ORKIN[1] and DANIEL M.A. PESSOA[4]

[1]Anthropology and Archaeology, University of Calgary, [2]Medical Genetics, University of Calgary, [3]Anthropology, Washington University in St. Louis, [4]Physiology, Federal University of Rio Grande do Norte

Reconstructing the activity patterns of early primates is critical for understanding primate origins and adaptive radiation. The persistence versus loss of functional opsin genes and color vision has been used to inform this debate. For example, the emergence of trichromacy in primates has been associated with frugivory and increasing diurnal activity. Among nocturnal primates, some species maintain dichromatic vision, while monochromatic vision (complete colorblindness) characterizes others. The factors contributing to this variation are not fully elucidated, but diet and habitat-specific light levels have been implicated. Comparisons drawn from other nocturnal taxa may help resolve this uncertainty. To investigate the impact of ecology on the color vision of nocturnal species, we sequenced partial *OPN1SW* and *OPN1LW* opsin genes for 20 species of leaf-nosed bats (family Phyllostomidae) with diverse diets. As with nocturnal primates, *OPN1LW* genes appear intact for all bat species. *OPN1SW* genes also appear intact and under purifying selection for most bats. However, we found evidence of *OPN1SW* pseudogenization in vampire bats, which are active under the darkest parts of the night, and independent *OPN1SW* loss in *Lonchophylla mordax*, a species that roosts in dark caves. Accordingly, the evolution of monochromacy in bats and primates has occurred under various evolutionary drivers; light level during foraging and low importance of chromatic cues during food search have likely contributed to color vision loss in both Orders. Evidence of functional opsins among many bats and primates, including insectivorous and frugivorous species, suggests that dichromacy remains adaptive for a wide range of nocturnal tasks.

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An Analysis of the Relationship Between Orbit and Cranial Metrics

RAPHAELA M. MELORO and VALERIE B. DELEON
Department of Anthropology, University of Florida

Midfacial traits exhibit marked covariance with other parts of the skull and may also exhibit distinct differences based on sex and ancestry. In applied work, these differences are used to estimate sex and ancestry from skeletal remains, but this becomes difficult in cases with fragmentary remains. This study uses multivariate analyses of linear data from the Howells dataset (N=989; https://web.utk.edu/~auerbach/HOWL.htm) to examine covariance between orbital metrics and other cranial metrics, and investigates the effects of sex and ancestry on orbital metrics. The sample was separated into three groups reflective of ancestries commonly referenced in modern American populations ("White," "Black," and "Native American"). Twenty-seven craniometric measurements were selected; nine were identified by Howells as informative of sex/ancestry, nine represented orbit shape, and nine captured overall cranial proportions. MANCOVAs were used to test the effects of sex and ancestry on metric data, and PCA was used to visualize results. Size was estimated by the geometric mean and included as a covariate. Integration between sets of metric data was tested using two-block PLS analysis. Results confirmed a significant effect of sex and ancestry on cranial metrics. Most of the metric variation was associated with sexual dimorphism. Covariation between orbit metrics and other metrics was significant. Orbit metrics alone displayed a significant effect of sex and ancestry, although there was significant overlap among groups. Geometric morphometric methods using landmark coordinates to define curves associated with the orbit may better distinguish these groups, and future work will include these approaches.

Type I Collagen Mutations Impede Craniofacial and Dental Growth

RACHEL A. MENEGAZ[1] and JASON M. ORGAN[2]
[1]Center for Anatomical Sciences, University of North Texas Health Science Center, [2]Department of Anatomy and Cell Biology, Indiana University School of Medicine

Type I collagen (Col1) is the primary organic component of bone. One genetic disorder of Col1, osteogenesis imperfecta (OI), is characterized by increased skeletal fragility and fracture risk, low bone mineral density, and shortened stature. The postcranial phenotype in OI has been studied extensively in experimental models, providing insight into the role of Col1 and its interactions with biomechanical loading in determining adult postcranial phenotypes.

Patients with the severe OI type III also exhibit midface hypoplasia, basicranial shortening, dental malocclusions, and sometimes compromised tooth properties. Compared to the postcrania, little is known about the etiology of the human craniofacial phenotype or its presentation in experimental models. Here we use a mouse model of OI type III in order to investigate the role of Col1 in the growth of the craniofacial skeleton.

The OI murine (oim) is a strain with a nonlethal recessively inherited mutation of the COL1A2 gene. Homozygous ($oim^{-/-}$) mice are a model for OI type III. Wild-type (WT) and $oim^{-/-}$ littermates were weaned at 21d and raised until adult (16 weeks). 3D landmarks were collected from serial in-vivo μCT scans, and Krusal-Wallis ANOVAs used to compare centroid sizes and morphometric distances between genotypes.

Relative to their WT littermates, adult $oim^{-/-}$ mice have smaller craniomandibular centroid sizes; decreased facial and basicranial lengths; decreased mandibular lengths, corpus heights, and toothrow lengths. Given its replication of the human phenotype, the oim model may be a potential avenue for understanding the influence of Col1 on craniofacial growth in varying biomechanical loading environments.

This work was support by an Indiana University Collaborative Research Grant and the Ralph W. and Grace M. Showalter Research Trust.

Realized Habitat Choices of Crowned Lemurs (*Eulemur coronatus*) in a Heavily Disturbed Forest Fragment: A Case Study of Flexible Distribution Patterns

FERNANDO M. MERCADO MALABET[1,2] and IAN C. COLQUHOUN[3,4]
[1]Anthropology, The University of Toronto, [2]School of the Environment, The University of Toronto, [3]Anthroplogy, The University of Western Ontario, [4]The Centre for Environment & Sustainability, The University of Western Ontario

Anthropogenic-driven loss of forest-habitats across Madagascar has resulted in the degradation of much of the island's original forest extent. As anthropogenic pressure and forest loss continue, it becomes increasingly necessary to properly assess whether endangered lemur populations that inhabit disturbed forest fragments can effectively obtain access to the necessary ecological resources and conditions required to sustain their behavioural processes. Our research addresses this current gap in knowledge by exploring how the habitat choice patterns of a small population of crowned lemurs (*Eulemur coronatus*) occupying a degraded forest fragment – located within the protected area of Oronjia Conservation Park in northern Madagascar – are realized by the influence of ecological and anthropogenic factors. We hypothesize that the distribution of *E. coronatus* within the fragment is limited by the variation of critical ecological resources and conditions, as well as the availability of habitat sections exhibiting low levels of human activity. To examine this, we present an ecological niche model (ENM) developed in MaxEnt, that uses: presence-only data detailing the occurrence of the population, and thirteen independent background variable detailing anthropogenic and ecological aspects of the site. The results from our model partially support our hypothesis, as they indicate that while the distribution of *E. coronatus* is primarily limited by the availability of ecological resources; it exhibits a more flexible response to anthropogenic disturbance. This research shows that the occurrence of *E. coronatus* across the site is a product of their need to maximize foraging opportunities while also avoiding environmental and anthropogenic stressors.

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Pediatric fracture healing and fracture location; a radiographic approach

DIANA L. MESSER[1,2,5,6], BRENT H. ADLER[3], FARAH W. BRINK[4], HENRY XIANG[5] and AMANDA M. AGNEW[6]
[1]Department of Biomedical Education and Anatomy, The Ohio State University, [2]Department of Applied Forensic Sciences, Mercyhurst University, [3]Department of Radiology, Nationwide Children's Hospital, [4]Center for Family Safety and Healing, Nationwide Children's Hospital, [5]Center for Injury Research and Policy, Nationwide Children's Hospital, [6]Skeletal Biology Research Lab, School of Health and Rehabilitation Sciences, The Ohio State University

In physically abused children, skeletal fractures often go undetected and untreated for a significant time, discovered later through radiographic survey. In such cases, time since injury (TSI) may be essential for characterization of abuse. Few, if any, radiographic methods to assess TSI take into account variables that may affect healing such as fracture location, despite preliminary research suggesting differences in healing exist between upper and lower limbs. This study examines the effect of fracture location on pediatric fracture healing through radiographic analysis.

Four hundred ninety-eight skeletal fractures (>1355 radiographs) at Nationwide Children's Hospital (Columbus, OH) were evaluated for features of fracture healing, specifically subperiosteal new bone formation (SPNBF) and callus formation. Features were recorded for presence, thickness, matrix, and character based on modified parameters set by Walters et al. (2014). Anatomical location was divided into upper limb (n=890) and lower limb (n=465). Skeletal elements included humerus (n=286), radius (n=227), ulna (n=190), clavicle (n=187), femur (n=194), tibia (n=171), and fibula (n=100). Within-bone location

(excluding clavicle) was simplified into proximal (n=188), midshaft (n=799), and distal (n=349).

Independence and goodness of fit frequency tests revealed differences in callus matrix based on bone type and within-bone location, but not between upper versus lower limb. Similarly, fracture location was found to influence SPNBF thickness depending on anatomical region, element, and within-bone location. These findings suggest future methods to assess TSI may need to consider the morphology and function of each skeletal element in relation to its specific fracture patterns and potentially be bone specific.

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Collective Violence in the Early Neolithic of Central Europe. Evidence from *Linearbandkeramik* (LBK) Mass Fatality Sites

CHRISTIAN MEYER[1,2], CORINA KNIPPER[3], VEIT DRESELY[2], HARALD MELLER[2] and KURT W. ALT[2,4,5]

[1]OsteoARC, Osteoarchaeological Research Center, [2]State Museum of Prehistory, State Office for Heritage Management and Archaeology Saxony-Anhalt, [3]Isotope Laboratory, Curt Engelhorn Center Archaeometry gGmbH, [4]Center for Natural and Cultural History of Man, Danube Private University, [5]Integrative Prehistory and Archaeological Science, University of Basel

The Early Neolithic (ca 5600-4900 cal BC) witnessed the introduction of the farming lifeway into Central Europe. Permanent settlements, inheritable farming plots and extensive cemeteries signify long-term investment into places fixed in the landscape by these first farmers which today are summarized as *Linearbandkeramik* (LBK).

Towards the end of this period, in the decades before 5000 BC, several mass fatality sites appear in the archaeological record as massacres and/or mass graves. While most seem quite similar overall, with men, women and children killed at each site, a newly analysed mass grave (Halberstadt, Germany) clearly deviates from the established patterns. Here, cranial injuries are tightly focussed at the back of the head, not spread out over the skull as at the other mass violence sites. The demography of the victims is almost exclusively male (89%) with an apparent lack of subadults.

In accordance with the theme of the symposium this new site is used as a starting point for a synthetic re-examination of the evidence for collective violence at the end of the LBK sequence. Utilizing Whitehead's "poetics of violence" approach, the role of group violence and the post-mortem treatment of the traumatized bodies is explored from different angles, specifically focussing on how cultural identity and group membership are tied into these events. It appears that the new LBK mass fatality site of Halberstadt may well represent an antipode to the known LBK massacres and that different identities are in fact expressed via collective lethal violence in these cases.

Toward solving the puzzle of thorax shape variation among early hominins

MARC R. MEYER[1], SCOTT A. WILLIAMS[2,3], DANIEL GARCIA-MARTÍNEZ[4,5] and MARKUS BASTIR[4]

[1]Anthropology Department, Chaffey College, [2]Center for the Study of Human Origins, Department of Anthropology, New York University, [3]New York Consortium in Evolutionary Primatology, [4]Paleoanthropology Group, Museo Nacional de Ciencias Naturales, [5]Biology Department, Faculty of Sciences, Universidad Autónoma de Madrid

Differences in thorax shape between humans and the great apes are well documented, with the narrow upper thorax and wide lower thorax of apes contrasting with the opposite pattern in fossil *Homo* and extant humans. Interestingly, current reconstructions of thoraces in small-bodied hominins, such as the *Australopithecus afarensis* A.L. 288-1, may feature a smaller, more apelike pulmonary thorax (upper thorax), while its larger-bodied conspecific KSD-VP-1/1 is suggested to be more human-like, with a relatively expanded upper thorax. Toward understanding this dichotomy, we examine the relationship between body size and thorax shape, and model trajectories of the upper limb relative to differently shaped thoraces.

We show that variation in thorax shapes facilitate or constrain certain locomotor patterns, as a small upper with an expanded lower thorax facilitates knuckle-walking, orienting the upper limb close to the sagittal midline and center of gravity during locomotion, and confers efficient scapular movement around the ribcage. Conversely, an expanded upper and small lower thorax better facilitates bipedality, facilitating more efficient arm swing and energy return from upper limb momentum, while lower thoracic expansion constrains arm swing in bipedal locomotion.

Since lung volume and body mass scale isometrically, increases in lung capacity (and concomitant expansion of the thorax) would be best apportioned to the lower thorax in knuckle-walkers. By contrast, increases in lung capacity and thorax expansion in bipeds are best apportioned superiorly. Thus, locomotor constraints, in concert with the isometric relationship between body size and lung size, may explain thoracic shape variation in early hominins.

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Evidence for seasonality from the Kiahera Formation from the Early Miocene deposits of Rusinga Island, Kenya

LAUREN A. MICHEL[1], KIMBERLY CHENG[1], RACHEL L. CHAN[2], ALEXSIS F. BOWEN[1], DAVID L. FOX[3], THOMAS LEHMANN[4], DANIEL J. PEPPE[5] and KIERAN P. MCNULTY[6]

[1]Department of Earth Sciences, Tennessee Tech University, [2]Department of Chemistry, Tennessee Tech University, [3]Department of Geology and Geophysics, University of Minnesota, [4]Messel Research and Mammalogy Department, Senckenberg Research Institute and Natural History Museum, [5]Department of Geosciences, Baylor University, [6]Department of Anthropology, University of Minnesota

The early Miocene deposits of Rusinga and Mfanango Islands (Lake Victoria, Kenya) have yielded an abundance of fossils, including the early ape, *Ekembo*, and other basal catarrhines. However, there have been disagreements about paleoenvironmental interpretations due in part to conflicting placement of fossil localities within geological formations. Here we present a detailed geological analysis of the poorly studied R73 fossil locality, to determine its stratigraphic placement and to reconstruct the paleonvironment of the site. Lithostratigraphic analyses indicate that R73 correlates to the Red Grit, Tuff and Red Grit, and Pisolitic Clay Members of the Kiahera Formation and does therefore not belong to the older Wayando Formation, as previously indicated by some authors. Paleosol analyses reveal well-developed Vertisols, calcic Vertisols, and Calcisols in the Pisolitic Clay Member demonstrating a period of landscape stability. Paleosols features including wedge-shaped peds and slickensides which indicate seasonal precipitation, and pedogenic carbonate which indicates that evaporation must have been greater than precipitation for at least part of the year. This reconstruction contrasts with temporal and spatial variability in environments of the younger Hiwegi Formation, which includes evidence for a closed canopy forest as well as more open woodlands. The evidence for seasonality at R73 may reflect a monsoonal pattern of precipitation in the region that may have played an important role in the evolution and diversification of early hominoids.

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A GIS-Based Analytical Approach to Bone Histology for Age Estimation Purposes

SUZANNA MICHENER[1], LYNNE S. BELL[1], DAVID SWANLUND[2] and NADINE C. SCHUURMAN[2]

[1]School of Criminology, Simon Fraser University, [2]Department of Geography, Simon Fraser University

Bone histomorphometrics is a heavily researched tool for adult age estimation in forensic and archaeological contexts. To date, all research has examined a single two-dimensional plane of study; that is, one transverse osteological section that utilizes frequency data. Not accounting for the volumetric nature of osteonal growth and development may explain the lack of accurate and replicable results in age estimation equations. The current study hypothesizes that a method incorporating spatial-temporal osteonal changes will improve histological age estimation.

Testing the hypothesis necessitated the development of a new methodology to provide three-dimensional visualization of osteonal changes. To achieve this result, ArcGIS, a Geographic Information Science (GIS) software, was utilized in combination with standard histological preparation techniques. First, three serial transverse sections of the midshaft of an adult femur enabled a three-dimensional perspective of histological change. Second, ArcGIS georeferencing tools projected and aligned the sections in real space. Third, polygon features delineating the cement line of individual complete osteons were manually created to overlay each remodeling event. Fourth, osteons were connected between the three sections providing an overall depth of approximately 840 microns. Lastly, change detection algorithms to quantify differences in area between remodeling events enabled volumetric calculations of individual osteons.

This approach to bone histomorphometry has yielded novel results regarding spatial patterns in osteonal size, orientation, and density. It has enabled the efficient calculation of the area and volume of osteons. This facilitates increased understanding of osteonal spatial-temporal relationships and may be used to improve histological age estimation equations.

Locomotor, phylogenetic, and allometric effects on anthropoid 3D pelvic anatomy

EMILY R. MIDDLETON[1], SCOTT D. MADDUX[2] and CAROL V. WARD[1]

[1]Pathology & Anatomical Sciences, University of Missouri, [2]Center for Anatomical Sciences, University of North Texas

Variation in pelvic morphology among anthropoids has generally been thought to reflect locomotor selective pressures on the thorax and pectoral girdle. Here we investigate the pelvis in three dimensions to explore how geometric relationships within this region vary across taxa and to what degree this variation tracks locomotor behavior and torso morphology. We collected landmark data using a Microscribe G2X on articulated pelves from 240 anthropoid specimens and used Principal Components Analysis to identify large-scale trends within the dataset. We then conducted a series of bivariate allometric analyses from linear metrics extracted from the coordinate data to further investigate taxonomic differences and scaling trends for specific aspects of pelvic morphology.

The analyses indicate a complex pattern of locomotor/phylogenetic and allometric influences on pelvic form. Apes have relatively narrower dorsal inter-iliac spacing than do most monkeys, with relatively smaller spinal muscle attachment areas but only minimally wider ventral bi-iliac breadths relative to body size. Hylobatids and atelids have a relatively more cranial position of their sacra than do other taxa for their size. Within groups, the three pelvic joints (lumbosacral, sacroiliac, hip) become relatively more closely positioned craniocaudally with increasing body size. Contrary to traditional interpretations that pelvic morphology reflects a difference in torso breadth between apes and monkeys, iliac shape and orientation are primarily determined by dorsal pelvic morphology related to spinal muscle mass and lumbar length. Observed patterns of pelvic variation, and their spatial determinants, are not fully apparent without consideration of the 3D morphology of the articulated pelvis.

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Urban warfare in the Crusades: Weapon injuries in 13th century mass grave deposits at the fortified town of Sidon (Lebanon)

RICHARD MIKULSKI[1], HOLGER SCHUTKOWSKI[1], MARTIN J. SMITH[1] and PIERS D. MITCHELL[2]

[1]Archaeology, Anthropology and Forensic Science, Bournemouth University, [2]Department of Archaeology and Anthropology, University of Cambridge

The Crusades to the Levant have been subject to rigorous academic study from historical and archaeological perspectives. Yet there have been remarkably few investigations of the physical remains of participants during this turbulent period, considering skeletal remains represent the most direct evidence for the events and processes that took place.

Between 2009 and 2010, two closely associated burial contexts containing a combination of partially articulated individuals, articulated body parts and disarticulated remains, were excavated at College Site, Sidon, Lebanon. Associated artefacts and radiocarbon dating of bones place the deposits firmly within the crusader period (AD 1097 – 1291).

Macroscopic analyses yielded an MNI of 25 for the two deposits. All remains for which age could be estimated fell within a range between 14 and 50 years. Almost all remains for which sex could be determined exhibited male characteristics. The remains exhibited multiple perimortem sharp force trauma to both cranial and postcranial elements, alongside perimortem blunt force trauma, with multiple injuries evident to at least two individuals. The distribution of observed injuries, coupled with the specific demographic profile, suggests the individuals died in battle rather than as victims of a massacre or formal execution. Results will be discussed in the bioarchaeological context of medieval conflict with consideration of potential links to documented historical events.

These mass graves provide the largest and most significant evidence for a crusader period battle in the Holy Land. Our analysis has great significance for the understanding of wounds sustained in battle in the medieval Middle East.

Chronological patterns of dental fluctuating asymmetry at Neolithic Çatalhöyük (Central Anatolia, Turkey, 7100-6000 cal BC)

MARCO MILELLA[1], CHRISTOPHER J. KNÜSEL[2] and IRENE DORI[2,3]

[1]Department of Anthropology, University of Zurich, [2]UMR 5199 PACEA, University of Bordeaux, [3]Depatment of Biology, University of Florence

One of the most important phenomena associated with the Neolithic is the appearance of densely populated settlements. This resulted in unprecedented exposure to pathogens and physiological stressors, and likely represented an important factor in human biocultural microevolution.

Çatalhöyük (Central Anatolia), one of the largest settlements of the Neolithic Near East, is characterized by archaeological features consistent with complex social interactions in the context of a densely populated settlement. Population estimates point to a population of between 3500 and 8000 individuals, with population growth characterized by a peak between 6250 and 6610 BC, and a subsequent decline.

In this contribution, we explore the developmental effects of changes in population density at Çatalhöyük by analyzing diachronic patterns in dental fluctuating asymmetry (FA). Specifically, we test two hypotheses: 1) we postulate a diachronic decrease in FA due to a decrease in population density, and 2) we expect the above pattern to be more pronounced for males due to their greater sensitivity to physiological stress. With this aim in mind, we collected a set of bucco-lingual and mesio-distal measurements of permanent canines and first and second molars for a large sample (N=257) representing both sexes and different chronological periods.

Results are consistent with the first hypothesis, pointing to a decrease in FA during the late phase

of occupation of the site but only partially support the expected differences between sexes.

Overall, this study provides new insights into the microevolutionary correlates of demographic changes during the Holocene, while also addressing sex differences in developmental stability.

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Developing a fecal detection method for monitoring Zika virus in Neotropical primates

KRISTA M. MILICH[1,2], BENJAMIN J. KOESTLER[3], JOE H. SIMMONS[4], ANTHONY DI FIORE[2], LAWRENCE E. WILLIAMS[4], JAQUELIN P. DUDLEY[3], JOHN VANCHIERE[5] and SHELLEY M. PAYNE[4]

[1]Anthropology, Washington University in St. Louis, [2]Anthropology, University of Texas at Austin, [3]Department of Molecular Biosciences, University of Texas at Austin, [4]MD Anderson Cancer Research Center, University of Texas, [5]Pediatrics, LSU Health Science Center at Shreveport

A new strain of Zika virus (ZIKV) has been spreading throughout the Americas and has been associated with severe birth defects, notably microcephaly. ZIKV was first isolated in the blood of nonhuman primates in Africa and has been detected in the blood, saliva, and urine of a few catarrhine species in Africa and Asia, suggesting that nonhuman primates may serve as both a source and a reservoir of the virus. The recent introduction of ZIKV to human populations in the Americas introduces the potential for the virus to spread into previously unoccupied nonhuman primate reservoirs. Thus, it is critical to develop efficient and noninvasive detection methods that will allow us to monitor the spread of the virus in Neotropical primates. Here, we provide the first evidence of ZIKV detection in noninvasively collected fecal samples from nonhuman primates. Fecal samples were collected post-exposure from two captive squirrel monkeys (*Saimiri boliviensis boliviensis*) experimentally infected with ZIKV (Strain Mexico_1_44). Nucleic acids were extracted from these samples and RT-qPCR was used to assay for the presence of ZIKV using primers flanking a 101 bp region of the sequence encoding NS5. In both subjects, ZIKV was detected 5-10 days post-infection. Comparisons to ZIKV detection in blood, saliva, and urine samples will also be discussed, as will the potential to extend the time-window for detection. These results have implications for cost-effective, noninvasive monitoring of wild populations of Neotropical primates as possible reservoirs of anthroponotic ZIKV.

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Breastfeeding and emerging infectious diseases: An anthropological approach

ELIZABETH M. MILLER

Anthropology, University of South Florida

Breastfeeding is said to protect infants against infection; however, the role of breastfeeding in the emerging epidemics is complicated by the potential for transmission of disease via milk, variations in milk immunobiology itself, and the multitude of culture-dependent behaviors surrounding infant feeding. This presentation is a case study for the biocultural contexts that could potentially accompany emerging infection among breastfeeding infants. The Ariaal are a group of largely-settled pastoralists in rural Kenya who participate in pastoralism and subsistence agriculture. One of the three villages surveyed did not have a health dispensary, vaccine coverage was incomplete, and 88% of women (n = 251 mother-infant pairs) reported using famine relief food within the past month. Mothers infrequently boiled water or cow's milk for young infants, increasing their exposure to fecal-oral and zoonotic infections. While diarrhea and fever were less common among infants, respiratory symptoms were widely reported (43%) and most infants lived in small traditional houses with fires inside, making infants vulnerable to emerging respiratory infections. Ariaal infants experience high rates of undernutrition, which makes them vulnerable to mortality from infection. Finally, anti-inflammatory biomarkers in the milk of Ariaal mothers were significantly lower than a population of urban U.S. women ($p < 0.0001$), calling into question the effects of variation in milk on infant health. Biocultural accounts of human populations that consider political-economic realities, human-environment-animal interactions, cultural beliefs and practices, and local biologies can help inform the contexts and vulnerabilities through which infectious diseases may (re)emerge and become virulent.

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Population level approaches to differential caregiving at a historic hospital

COLLEEN F. MILLIGAN[1] and LISA N. BRIGHT[1,2]

[1]Anthropology, California State University, Chico, [2]Anthropology, Michigan State University

The bioarchaeology of care was introduced to examine caregiving at the individual level, and has typically been applied to prehistoric case studies. The shift to population level analyses remains a challenge. Health and disease cannot be disassociated from the larger socio-political context; any population level examination of caregiving must also have a deeply embedded engagement with archaeological and historical context. Historic skeletal collections, with their typically large sample size and historic documentation, provide excellent opportunities to apply a population level approach to the bioarchaeology of care.

Many of the historic skeletal samples in the U.S. are associated with institutions (i.e. hospitals, poorhouses, asylums). The present study assesses caregiving at the institutional level, both within a large-scale historic public institution and broader health-related public policy. Using paleopathological, demographic, archaeological, and historical data, evidence of differential caregiving was assessed in 1,004 individuals exhumed from the Santa Clara Valley Medical Center Historical Cemetery (SCVMC), San Jose, California. This cemetery was associated with the Santa Clara County Hospital, and served as a potter's field from 1875-1935.

Poverty diminishes the protective status conferred by specific genders, ethnicities, and religions, as it crosscuts these categories. Indigent populations were marginalized, institutionalized, and ostracized. However, this study reveals that immigration status was an even greater determinant for access to care. Recent immigrants faced differential access to caregiving resources, revealing the subtexts of structural violence in charitable care provisioning. These findings highlight the importance of considering variation within a skeletal population when applying a population level bioarchaeology of care.

Macroevolution of tail morphological diversity in primates and other mammals

SARAH T. MINCER[1] and GABRIELLE A. RUSSO[2]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [2]Department of Anthropology, Stony Brook University

Tail morphology – including aspects of length and prehensility – is diverse among mammals, including primates. Equally as diverse are the factors (e.g., substrate use, locomotion) previous studies propose to have influenced the evolution of tail morphological diversity. However, function-related selective pressures on tail morphological evolution have not been empirically tested at a larger phylogenetic scale. Here, we address this issue and offer new insight into the evolution of tail morphological diversity by using phylogenetic comparative methods to 1) map evolutionary patterns of tail morphology to visualize the phylogenetic context of certain trait shifts, and 2) quantify relationships between tail morphologies and various ecological and

behavioral categorical variables across mammalian orders and within primates. In addition to the strong effects of shared ancestry, results demonstrate that among mammals and within primates grouped by substrate use (e.g., arboreal, semiarboreal, semiterrestrial, and terrestrial), arboreal species have longer tails compared to all other groups. Among mammals grouped by locomotor mode, gliders, arboreal quadrupeds, and bipedal hoppers have the longest tails, while burrowers and quadrupedal hoppers have the shortest tails. Within primates, arboreal quadrupeds and tail-assisted suspensors have the longest tails, while brachiators and quadrupedal climbers have the shortest tails. We discuss in depth the role of phylogeny, other factors thought to influence tail length (e.g., thermoregulation, diet), and the evolution of prehensility. Our study highlights the multi-functionality of the tail, and provides a holistic overview of how it may have responded to different ecological and behavioral pressures throughout mammalian and primate evolutionary history.

Enthesophytes: Correlation of Bony Growth at Tendon Insertion Sites with Socio-Demographic Factors in European American and African American Individuals

CLAIRE E. MINCHER[1] and SEAN D. TALLMAN[1,2]

[1]Anatomy and Neurobiology, Boston University School of Medicine, [2]Anthropology, Boston University

Individualization of skeletal remains is a critical component of archaeological and forensic investigations. Bone growth at tendon insertion sites, or enthesophytes, have been researched as individualizing musculoskeletal stress markers and were previously shown to relate to age, body mass, and possibly occupation; however, no such research exists regarding ancestral correlations. Research shows that African American bone density is significantly higher than other ancestral groups; thus, it is hypothesized that African Americans have a higher tendency for additional bone growth in relation to age, body mass, and occupation. To test this hypothesis, 230 individuals from the William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville, were analyzed following previously established and revised standards for scoring enthesophyte development in the upper and lower limbs. The individuals were of European American (n=176) and African American (n=54) ancestry, and were scored at random for enthesophyte development before reviewing demographic information. Each tendon insertion site was compared to the demographic information and ancestral origin of the individuals. The results confirm the expected link between enthesophyte development with age and body mass, while additional comparisons of the scores display a possibility that African Americans to display greater bone development at tendon insertion sites. Further, upper limb scores displayed stronger correlations with demographic information than the lower limb, providing a better focus for future research. The correlation of enthesophyte development with demographic information may aid in anthropological investigations, providing an additional method for individualization and identification of biomechanical stresses in skeletal remains.

Sex differentials among groups exhibiting increased survivorship on the North American Great Plains

JOCELYN D. MINSKY-ROWLAND

Anthropology, The University of Tennessee, Knoxville

Anthropologists concerned with the impact of childhood skeletal stress marker on later adult survivorship have consistently questioned what 'health' means. Previous research compared the effect of skeletal stress markers on adult survivorship among the Arikara Native Americans associated with four archaeological sites (AD 1600-1832). Females exhibiting a visible skeletal stress marker exhibited increased survivorship after age 40, compared to males. Males lacking a skeletally visible stress marker exhibited increased survivorship after age 40, compared to females. Previously, it was hypothesized that the experience of a stressful event in childhood conferred an immunological benefit for adult females, but not for adult males. The current project compares the survivorship of adult females with a visible skeletal stress marker with the survivorship of males lacking a skeletally visible stress marker. Thus, the survivorship of two subgroups, previously suggested to have an inherent biological strength, is being compared. Survivorship of 179 adult individuals, out of 374 discreet individuals was estimated using Kaplan-Meier estimates with log-rank tests in SPSS version 22. The results were not statistically significant. The associated survivorship curves indicate that both groups in this subsample lived to about age 80. These results further suggest that the experience of a stressful event in childhood may have primed the female immune system for increased survivorship, but for males, increased survivorship was achieved if they did not experience such an event. This study contributes to research concerned with the significance of skeletal stress markers on adult survivorship and differential survivorship between the sexes.

Genetic relationships of hunter-gatherer societies on the Texas Coastal Plain

AIDA T. MIRO-HERRANS[1], KRISTIN CORL[2], ROBERT J. HARD[2], RAYMOND P. MAULDIN[2], JOHN M. ANDERIES[3], JACOB FREEMAN[4] and DEBORAH A. BOLNICK[1,5]

[1]Department of Anthropology, University of Texas at Austin, [2]Department of Anthropology, University of Texas at San Antonio, [3]School of Human Evolution and Social Change, Arizona State University, [4]Anthropology Program, Utah State University, [5]Population Research Center, University of Texas at Austin

For over 6,000 years, the hunter-gatherer societies who inhabited the Texas Coastal Plain used communal mortuary locations. We model these societies as maintaining local territories but interacting via systems of well-developed social networks. These systems persisted for millennia, but suddenly collapsed ~700 years ago (ya). We studied mitochondrial DNA from three archaeological sites spanning 3,000 years to assess whether genetic exchange accompanied the cultural exchange observed in the archaeological record. Two archaeological sites (Morhiss and Ernest Witte) include samples that date from 3,000 to 300 ya, while the third site (Mitchell Ridge) includes samples that date from 1,500 to 200 ya. We extracted ancient DNA from teeth or petrous bone from 55 individuals. For samples with good endogenous DNA content, we uniquely identified each sample with a genetic barcode and targeted whole mitochondrial genomes for capture and sequencing. We obtained whole mitochondrial genomes for 4 Morhiss samples, 4 Ernest Witte samples, and 16 Mitchell Ridge samples. Our results show that samples from the Ernest Witte site have higher mitochondrial diversity than samples from the Morhiss or the Mitchell Ridge sites. Moreover, more recent samples from Mitchell Ridge (700-200 ya), from one burial area within the archaeological site, exhibit the same haplogroup, suggesting that this population experienced population decline or isolation during this period. We discuss the implications of these genetic relationships for our understanding of ancient social networks in this region. These results provide the first genetic insights into patterns of ancient human genetic diversity on the Texas Coastal Plain.

This study was funded by the National Science Foundation.

Hip joint ankylosis and femur adaptation: Ancient human bone histology case study from the Metal Period Philippines

JUSTYNA J. MISZKIEWICZ[1], CLAIRE RIDER[1], SHIMONA KEALY[2] and MARC F. OXENHAM[1]

[1]School of Archaeology and Anthropology, College of Arts and Social Sciences, Australian National University, [2]School of Culture, History, and Language, Archaeology and Natural History, College of Asia and the Pacific, Australian National University

It is now well established that changes in mechanical load can affect limb bone macro- and microscopic bone adaptation. However, limited

research has been undertaken investigating the biomechanical effects of one-sided hip joint pathology on lower limb bone structure. This study examines skeletal traits of the left and right femur in an archaeological individual who presented with an ankylosed hip joint, and would have experienced difficulty with mobility in the years prior to his death. A macroscopic examination, utilising qualitative and quantitative assessment of left and right femur size and shape, was undertaken on an individual representing a middle-aged male from the Metal Period Nagsabaran, Philippines. Vascular canal density was then examined in histological sections from left and right posterior midshaft femur to gain insights into cortical bone metabolism and remodeling.

The overall morphology and outer bone appearance of the ankylosed femur were poorly expressed and of smooth topography. Morphometric data indicated cortical thinning. Higher density of cortical pores examined using static histomorphometry was observed. Geographic information system (GIS) software was used to map cortical pore density in the endosteal and periosteal bone, revealing a statistically significant (*p*. = 000) reduction in its average pore-to-pore distance in the ankylosed sample. Results indicate that abnormal mechanical load of the lower limb has negative effects on skeletal adaptation and, if prolonged, results in bone "wasting".

Tuberculosis and leprosy interaction: the potential role of other Mycobacterial species on training innate immunity

HALEIGH MITCHELL and FABIAN CRESPO

Department of Anthropology, University of Louisville

Leprosy and tuberculosis are closely related infectious diseases. Leprosy declined in Western Europe after the 13th century and one hypothesis suggests cross immunity exists between *Mycobacterium leprae* and *Mycobacterium tuberculosis*. Interestingly, the family *Mycobacteriaceae* contains more than 100 species and it is known that different species share many antigens, and it can be expected that there would be a complex pattern of immunological interaction between concomitant infections (or casual exposure) to different species. Recently, it was proposed that "trained immunity" should be used to describe enhanced innate host defense mechanisms against reinfection or new infection with different pathogens. The main objective of our study is to re-visit the cross-immunity hypothesis between *M. tuberculosis* and *M. leprae* studying the expression of key cytokines (TNFα and IFNγ) involved in the immune response against both pathogens when considering early exposure to other mycobacterial species such as *M. bovis* and *M. smegmatis*. We developed *in vitro* protocols using human immune cells to study if exposure to one *Mycobacterium* species (whole lysate or antigens) can generate an immunological shift affecting the immune response to leprosy pathogen. The final cytokine expression was measured by ELISA. Our results show that early exposure to other mycobacterial species can modify the *in vitro* inflammatory response against the leprosy pathogen. These results suggest that early exposure to other mycobacterial species can prime the cellular immune response. Therefore, trained innate immunity by other mycobacterial species should be considered as another factor when exploring the potential interaction between tuberculosis and leprosy.

Biases in Representation: A Geometric Morphometric Analysis of Distortions in Illustrations from 19th Century Craniology

PAUL WOLFF. MITCHELL

Anthropology, University of Pennsylvania

Although much attention has been given to questions of accuracy and bias in the measurements and data of 19th and early 20th century craniology, from Samuel George Morton to Franz Boas, relatively little attention has been paid to the rich and important visual history of the discipline. Prior to the widespread use of photography and photographic printing technologies in the late 1800s, natural historians and anthropologists, including Camper, Blumenbach, Morton and Retzius, relied on illustrations to demonstrate the features of human form described in their texts. As very few members of the lay or scientific community would have had access to the skulls illustrated in craniological texts, for almost all readers, illustrations demonstrated and substantiated the claims about human differences made in the text. Geometric morphometric (Procrustes superimposition) and linear craniometric analyses were used to compare accurate digital models of skulls from 3D laser scans from historical craniological collections to illustrations of the same skulls in 19th century texts, revealing significant inaccuracies in the illustrations. Focusing on the Samuel George Morton (1799-1851) Cranial Collection in Philadelphia and his publications *Crania Americana* (1839) and *Crania Aegyptiaca* (1844), a quantitative analysis of these inaccuracies suggests biases in the representation of crania and demonstrates how these distortions were used to advance claims for racial hierarchy in the 19th century, presenting a cautionary case study from the history of the discipline in the potential dangers of limited access to primary data.

The cliff edge model of obstetric selection predicts intergenerational predisposition to Caesarean delivery

PHILIPP MITTEROECKER

Dept. of Theoretical Biology, University of Vienna

The recently presented cliff edge model explains the evolutionary dynamics underlying the relatively high incidences of fetopelvic disproportion (FPD) in human childbirth. The model also predicts that the regular application of life-saving Caesarean sections during the last decades has triggered an evolutionary increase of fetal size relative to the dimensions of the maternal birth canal, which in turn has inflated incidences of FPD by roughly half a percentage point. This prediction about evolutionary change in modern society is difficult to test with epidemiological data on Caesarean section rates, which have increase much more rapidly for numerous other reasons. But the model also implies that women born by Caesarean because of FPD are more likely to develop FPD in their own childbirth compared with women born vaginally. By drawing from the formalism of the cliff edge model, we predict a risk ratio of 2.8 – an effect size much larger than that of the predicted evolutionary change. Multigenerational epidemiological studies confirm this prediction surprisingly well. The congruence between these data and our prediction lends support to the cliff edge model of obstetric selection and its evolutionary implications, despite the genetic and anatomical idealizations involved.

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Effect of pelvic girdle articulation methods on interobserver error in measurements of the bony pelvis of apes

ELIZABETH A. MOFFETT[1] and EMILY R. MIDDLETON[2]

[1]Structural Medicine, Rocky Vista University, [2]Pathology and Anatomical Sciences, University of Missouri

The pelvic girdle represents a complex structure that comprises the os coxae and fused sacral elements. Rearticulation of the pelvic girdle may introduce error in several ways: (1) the normal morphology of the sacroiliac joint allows for multiple potential positions of the sacrum; (2) female pelves are gracile and susceptible to postmortem joint surface damage, introducing potential variability during reassembly; (3) putty use during rearticulation may differ between observers; and (4) choice of type II and III landmark placement may differ between observers. For this study, two observers collected 3D landmarks on 166 individuals from *Homo sapiens*, *Pan troglodytes*, and *Hylobates lar*. Pelvic articulation methods differed slightly between observers, primarily regarding putty use at joint surfaces. Linear metrics - including mediolateral and anteroposterior dimensions of the birth canal, as well as biASIS, biPSIS, and biacetabular breadth - were extracted from landmark data. Interobserver error in linear measurements was quantified using coefficient of determination, median absolute

difference between paired observations, and technical error of measurement. Results indicate that measurements with the lowest error rates were mediolateral inlet and midplane breadths, anteroposterior inlet breadth, and biASIS. The least comparable metrics between observers were mediolateral outlet breadth and biPSIS, possibly due to variability in landmark placement between observers. For *H. sapiens*, female measurements had generally higher error rates than those of males, but this was not true for the other taxa. The results of this study indicate that caution should be used when combining pelvic landmark data from multiple observers.

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A case of systematic unilateral degenerative joint disease (UDJD) in 14th-17th century Transylvania and its implications for the effect of mining on population health

PRISCILLA B. MOLLARD

Anthropology, The University of Massachusetts Amherst

The Piaţă Cetăţii skeletal collection is comprised of a hitherto unstudied assemblage of over 800 individuals from 14th-17th century Transylvania. Located in the mining town of Baia Mare, the Piaţă Cetăţii cemetery represents an unprecedented opportunity to study the impact of mining on population health during this critical historical period, defined not only by social and political upheaval but also by rapidly accelerating advances in metallurgical technology. This poster summarizes osteological analysis of Complex 761, an adult male presenting systematic unilateral degenerative joint disease (UDJD) throughout the bony elements of the right side of the body. Withering of the bony elements of the left side of the body is not observed, thus suggesting that asymmetrical wear on the joints was neither the result of paralysis nor stroke. The biological profile of Complex 761 is summarized, as is a survey of pathology in comparison with the larger subsample of the Piaţă Cetăţii collection analyzed thus far (n= 20). These are presented in the context of late medieval mining practices and metallurgical technologies, represented by both contemporaneous imagery and material culture. Full analysis of the Piaţă Cetăţii cemetery, including the present study, is supported by collaborations among the University of Massachusetts Amherst, the Institut de Antropologie "Francisc J. Rainer", and the Muzeo Județean de Istorie și Arheologie Maramureș.

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Sodium is the likely target of geophagy in Nepal gray langurs

ELIOT T. MONACO[1], ANDREAS KOENIG[1,2], JULIA NIKOLEI[3], KARSTEN WESCHE[4,5,6] and CAROLA BORRIES[1,2]

[1]Interdepartmental Program in Anthropological Sciences, Stony Brook University, [2]Department of Anthropology, Stony Brook University, [3]Institute of Biology, Free University Berlin, [4]Botany Department, Senckenberg Museum of Natural History Görlitz, [5]., German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, [6]International Institute Zittau, Technische Universität Dresden

Primates may engage in geophagy to 1) detoxify the gut by neutralizing plant secondary compounds, e.g., in leaves, 2) alleviate acidosis caused by high intake of soluble carbohydrates, e.g., sugary fruits, or 3) acquire mineral nutrients to supplement the diet. These hypotheses were tested in Nepal gray langurs (*Semnopithecus schistaceus*), a forestomach fermenting colobine species, at Ramnagar, Nepal. These langurs fed predominantly on leaves and fruits at alternate times of the year. We observed adult langurs (N = 21) for one year (773 hours) to obtain data on feeding time. Rainfall data were collected to determine wet and dry seasons. Soil samples were collected to determine pH and mineral (sodium, potassium, magnesium, and calcium) concentrations of consumed vs. control soil. Feeding time analyses showed no correlation between soil consumption and feeding on either high-tannin or high-sugar foods (GLMM). Soil pH was not significantly higher in consumed samples and was lower than the normal pH range of a colobine forestomach. Of the minerals tested, sodium alone was significantly higher in consumed soil (MW U test; $p < 0.01$). For langurs in this population, sodium acquisition was the most likely function of geophagy, which is consistent with many reports for herbivorous animals. Although alleviation of acidosis is often proposed to explain geophagy in animals with ruminant-like digestion, such as colobines, this was not supported, nor was detoxification. These functions also lack support in studies of other wild primates.

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Phylogenetic implications of new craniodental character data for *Ardipithecus ramidus*

CARRIE S. MONGLE[1], DAVID S. STRAIT[2] and FREDERICK E. GRINE[3]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [2]Anthropology, Washington University in St. Louis, [3]Anthropology and Anatomical Sciences, Stony Brook University

Phylogenetic relationships among hominins provide a necessary framework for assessing their evolution. Reconstructing these relationships hinges on the strength of the character data analyzed. The phylogenetic position of *Ardipithecus ramidus* is critical to understanding early hominin evolution, and while many accept that it is the most likely the sister taxon to all later hominins, others have argued that *Ar. ramidus* was ancestral to *Pan*. Although the study by Strait and Grine (2004) suggested the former, available evidence permitted only 24% of characters in the matrix to be assessed for *Ar. ramidus*. Fossils described subsequently by Suwa, White and colleagues in 2009 have enabled the number of characters that can be coded for this species to be expanded to 79% of the matrix. Here, we incorporate these new character data to evaluate their impact on the phylogenetic relationships of *Ar. ramidus*. Because the quality of the data that comprise the character matrix determines the strength of any cladistic analysis, we have further revised the Strait and Grine (2004) matrix as necessitated by additions to the hypodigms of other fossil taxa. This updated matrix was analyzed using both parsimony and Bayesian techniques. Despite the new data and matrix revisions, tree topology has remained remarkably stable. *Ardipithecus ramidus* is reconstructed as being derived relative to *Sahelanthropus,* and as the sister to all later hominins. These findings support the phylogenetic hypothesis originally proposed by White and colleagues in 1994. Moreover, this updated matrix provides a framework with which to assess new fossil discoveries.

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Skeletal markers of activity among subsistence regimes

MAGGIE L. MOORE

Cultural Resources Laboratory, Atkins

Repetitive activities may leave particular signatures on the skeleton in the form of musculoskeletal stress markers (MSMs) at muscle attachment sites or signs of joint modification such as articular surface porosity (ASP). Patellae from five archaeological skeletal populations engaged in different subsistence regimes (n=180 individuals, two agriculturalist, one horticulturalist, and two hunter-gatherer groups) were qualitatively scored to determine whether these MSMs and joint changes vary between populations and among groups engaged in similar subsistence regimes, and if consistent patterns of MSMs and joint changes can be detected between subsistence regimes. Patellae were examined for MSMs at the quadriceps femoralis tendon attachment (QFTA) and the patellar ligament attachment (PLA) and for ASP. Chi-square tests of independence confirmed significant ($p \leq 0.05$) variation in all three observations between all five populations, with consistent patterning among the two agriculturalist populations and the two

hunter-gatherer populations. When populations were aggregated, significant variation existed between the subsistence regimes. Adjusted residuals indicate that agriculturalists exhibited significantly higher prevalence of QFTA MSMs and ASP (3.07 and 5.06 standard deviations, respectively), and hunter-gatherers a higher prevalence of PLA MSMs (3.03 standard deviations). Horticulturalists fell in between the other two groups, but more closely resembled hunter-gatherers. This analysis demonstrates significant and patterned variation in MSMs and joint changes to the patella between subsistence regimes. These skeletal signatures may inform on the lifeways of prehistoric peoples by providing evidence for particular subsistence activities such as corn grinding, evidenced among the agriculturalist groups by the combination of QFTA MSMs and ASP.

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Reconstructing the Population History of South Asia

PRIYA MOORJANI[1,2,3], NATHAN NAKATSUKA[3], NICK PATTERSON[4], LALJI SINGH[5], KUMARASAMY THANGARAJ[6,8] and DAVID REICH[3,7,8]

[1]Molecular & Cell Biology, University of California, Berkeley, [2]Department of Biological Sciences, Columbia University, [3]Department of Genetics, Harvard Medical School, [4]Medical and Population Genetics, Broad Institute of Harvard and MIT, [5]Genome Foundation, Hyderabad, [6]Centre for Cellular and Molecular Biology, CSIR, [7]Howard Hughes Medical Institute, Harvard Medical School, [8]These authors contributed equally

Most Indian groups descent from a mixture of two highly divergent populations: Ancestral North Indians (ANI) related to Middle Easterners, Central Asians, and Europeans; and Ancestral South Indians (ASI) not closely related to groups outside the subcontinent. The mixture is pervasive and impacts nearly every group in India, including upper and lower caste traditional groups, as well as isolated tribal groups. Using a novel method that leverages genomic patterns of population mixture, we estimate that the ANI-ASI mixture occurred 1,900 to 4,200 years ago. In many upper caste and northern groups, we find evidence for multiple pulses of mixture. In a subset of isolated tribal groups, 100% of the mixture is consistent with having occurred during this period. These results demonstrate that India experienced a demographic and cultural transformation in the last few thousand years, changing from a region in which major population mixture was common to one in which mixture even between closely related groups became rare because of a shift to endogamy. Beyond the cultural importance, this transformation is also medically relevant as it has led to strong founder events in many Indian groups, more extreme than those in Ashkenazi Jews and Finns, both of which have high rates of recessive disease due to founder events. This highlights an underappreciated opportunity for reducing disease burden in India, through the discovery and testing of recessive disease mutations.

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Co-shaping conservation dynamics: moor macaque (*Macaca maura*) life history stage and human knowledge, perceptions, and experience influence interspecies interactions in South Sulawesi, Indonesia

KRISTEN MORROW[1] and ERIN P. RILEY[2]

[1]Anthropology, University of Georgia, [2]Anthropology, San Diego State University

Human and nonhuman primates (primates, hereafter) interact with one another in diverse ways. Although the nature of these interactions has been well documented, we still have limited insight as to *why* humans and primates interact in the patterns we observe. Drawing from life history theory, social network analysis, and human-animal studies, we used an ethnoprimatological approach to examine interactions between humans and a group of moor macaques (*Macaca maura*) along a provincial road in South Sulawesi, Indonesia. Between August 2016-January 2017 we collected behavioral data to investigate how life history and social network factors influence primates' tendency to interact with humans and how these interactions affect primate social networks. We also documented patterns of primate-directed behavior displayed by humans and conducted interviews to assess motivations for interacting with primates. We found that life history factors (age-sex), but not social network factors (associate's age-sex) predict individual's likelihood of being along the road. The macaques' social network was significantly more fragmented along the road as compared to the forest and was characterized by shifts in network roles across context. Interviews revealed that empathy, conceptions of nature, and knowledge of/prior exposure to primates all shaped how and why people interacted with the macaques. These findings further our understanding of how the human-primate interface is co-shaped by both species. This study also provides important conservation insights; specifically, we demonstrate the extent to which human interactions disrupt primate social behavior and how humans' diverse motivations for interacting with primates pose complex conservation challenges.

The Sex that Binds: Genito-genital rubbing is associated with increases in urinary oxytocin among wild female bonobos

LIZA R. MOSCOVICE[1,2], MARTIN SURBECK[1], BARBARA FRUTH[3], GOTTFRIED HOHMANN[1] and TOBIAS DESCHNER[1]

[1]Department of Primatology, Max Planck Institute for Evolutionary Anthropology, [2]Department of Anthropology, Emory University, [3]Department of Natural Sciences, Liverpool, John Moores University

Investigating contrasts in social dynamics between chimpanzees and bonobos can provide insights into the phylogenetic origins of human sociality. Compared with chimpanzees, bonobos have been characterized by higher levels of female intra-sexual cooperation and greater frequencies of socio-sexual behavior, including copulations and female genito-genital rubbing (GG-rubbing). Several aspects of chimpanzee social relationships have been linked to the oxytocinergic system. However the hormonal mechanisms underlying affiliation have not been studied in bonobos. We tested whether different social behaviors were associated with a rise in urinary oxytocin (uOT) in female bonobos. We measured uOT in N=195 samples from fifteen females at LuiKotale at baseline (without prior social interactions) or following socio-sexual behavior or grooming, with female or male partners. In-line with bonobo social dynamics, we predicted that socio-sexual behavior would elicit the strongest increase in uOT. We also predicted that, in contrast to chimpanzees, the magnitude of uOT changes would be influenced by the sex of the partner, rather than by the strength of dyadic social relationships. As predicted, socio-sexual behavior was associated with increases in uOT, but only following GG-rubbing. uOT following copulations or grooming did not differ from baseline. Fluctuations in uOT following socio-sexual behavior were explained by the sex of the partner, but not by the strength of social relationships. Fluctuations in uOT following grooming were not explained by either predictor. These results suggest a mechanism by which GG-rubbing may facilitate social tolerance, and provide a physiological basis for variation in social dynamics among our closest phylogenetic relatives.

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The eyes have it: Using spontaneous visual orientation to track the development of social awareness across socio-ecological settings in wild infant olive baboons (*P. anubis*)

CORINNA A. MOST and SHIRLEY C. STRUM

Anthropology, UC San Diego

Tracking spontaneous visual orientation (SVO) in response to stimuli is a common research method in developmental studies of human

infants, as it allows the investigation of budding cognitive abilities in pre-verbal children. However, few observational studies of non-human primates have adopted this method, likely due to the logistical difficulties of collecting such data in wild animals. Here we present data collected over the course of 2 years on the SVO of wild infant olive baboons (*P. anubis*). These animals are large-bodied, terrestrial, and habituated to humans, all of which facilitated collection of the data. We found a strong correlation between infant age and rates of SVO towards social interactions (p<.001), reflecting the expected development of infant social awareness. We also found significant effects of social factors on infant visual orientation, with low-ranking infants displaying lower rates of SVO towards interactions (p<.05), and infants with strong attachments to older siblings displaying higher rates of SVO (p<0.01). We then compared infant SVO in two troops ranging in areas that differ in the availability of a calorie-rich plant food source, which has led to faster reproductive rates and earlier weaning in one of these troops, and found that infants belonging to this troop displayed slightly higher rates of SVO (N.S., p=.053). These results demonstrate that SVO can be a valid method when investigating the development of social awareness in non-human primates, and that it has the potential to shed light on the effects of the social and ecological factors that influence this development.

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Comparing Age-Related Bone Loss Between Archaeological Populations Using Linear Mixed Effects Models: A Control for Diagenesis

REBECCA V. MOUNTAIN

School of Anthropology, University of Arizona

Diagenesis poses a major problem for bioarchaeologists. The structural changes to bone in the post-depositional environment can affect element preservation, antemortem pathologies, and isotopic composition. Bone mineral density (BMD), an important indicator of age-related bone loss in archaeological populations, is also affected by diagenesis through demineralization and mineral deposition. These processes not only affect the absolute measurement of BMD in archaeological remains, but also prevent the comparison of BMD between different archaeological sites due to their unique chemical, hydrological, and microbial environments. This represents a major barrier to comparing bone health between multiple populations. The aim of this study is to present a new statistical method for addressing diagenetic changes and comparing BMD between archaeological samples, as well as living populations, using a linear mixed effects model. Using a case study of three distinct archaeological skeletal samples from Arizona dating between 500 BCE and AD 1900, this study demonstrates the application of the linear mixed effects model, providing a relative and comparable measure of BMD across diagenetic environments independent of measurement techniques. This method allows for comparisons between geographically and temporally unrelated populations by controlling for diagenetic effects, removing the need for destructive analyses or correction factors.

The ligamentum teres femoris is present in some infant orangutans

MAGDALENA N. MUCHLINSKI[1], ADAM HARTSTONE-ROSE[2] and ASHLEY S. HAMMOND[3,4]

[1]Anatomical Sciences, University of North Texas, [2]Department of Cell Biology & Anatomy, University of South Carolina, [3]Department of Anthropology, Center for Advanced Study of Human Paleobiology, The George Washington University, [4]Human Origins Program, Department of Anthropology, National Museum of Natural History, Smithsonian Institution

It is widely viewed that orangutans lack a ligamentum teres femoris (LTF) because they lack a distinct fovea capitis on the femoral head. Orangutans require a high level of hip joint mobility because they employee acrobatic quadrumanual clambering, and the absence of an LTF is believed to be an adaptation to increase hip mobility. However, there are conflicting reports in the literature about the orangutan LTF. Here we perform a dissection-based study of orangutan hip joints, assess the soft tissue and hard tissue correlates of the orangutan LTF, and histologically examination the LTF (when present) to evaluate whether it is homologous to that found in other hominoids. The hip joints of five orangutans (n=3 infants, n=2 sub-adult/adult) were dissected and we observed an LTF inserting in the center of the femoral head in two of the infant orangutans. Skeletonized orangutan femora in osteological repositories (n=26 individuals) were examined for evidence of a foveal pit. We observed a foveal scar (no pit) in 8% of the sample. Histological examination of the infant LTF shows a distinct artery coursing through the LTF to the head of the femur. Despite being absent in adults, the LTF is present in at least some orangutans during infant development. We suggest that the LTF maintains a role in blood supply early in life. Other (probably biomechanical) factors result in the loss of the LTF later in life. These findings enhance our understanding of orangutan hip morphology and underscore the need for future soft tissue investigations.

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Lower testosterone levels are associated with higher risk of death in men: Evidence from the National Health and Nutrition Examination Survey

MICHAEL P. MUEHLENBEIN[1], ERIC C. SHATTUCK[2] and COREY S. SPARKS[3]

[1]Anthropology, Baylor University, [2]Anthropology, University of Texas at San Antonio, [3]Demography, University of Texas at San Antonio

Androgens exhibit immunomodulatory actions, some of which are considered suppressive. High testosterone levels may increase susceptibility to infectious and chronic diseases, and may therefore be associated with varying rates of mortality. This illustrates the roles that hormones play in altering trade-offs between life history traits like growth, reproduction, and survivorship. To investigate the relationships between testosterone and mortality in men, data from the National Health and Nutrition Examination Survey were analyzed (1984 to 2004). The outcome variable was all cause mortality within five and ten years of initial survey; the independent variable was serum testosterone (ng/ml). Death certificate information for all individuals who died up to year 2011 was used (n = 2561). Standard data extraction techniques were employed; a discrete time hazard modeling strategy was used to analyze data. In order to control for baseline risk factors, a variety of covariates were included, like C-reactive protein (a biomarker of inflammation), race/ethnicity, and socioeconomic status. Results indicate that very low levels of testosterone (<5 ng/ml) are associated significantly with the risk of death within five (93% excess risk) and ten (26% excess risk) years of follow-up. Although we can only speculate about directionality and causality, these results likely reflect the phenomenon that testosterone levels decrease in response to most infectious and chronic diseases investigated to date. Ill individuals would be expected to have both higher mortality and lower testosterone levels.

Functional adaptation in cortical and trabecular bone: different reflections of activity

BRAM MULDER, JAY T. STOCK, SARAH INSKIP, CRAIG CESSFORD and JOHN ROBB

Department of Archaeology, University of Cambridge

With bone adapting its structure to mechanical loading, its morphology provides a record of loading history. Analyzing mechanical properties of skeletal elements may thus be informative of activity patterns in past populations. Although both cortical and trabecular bone have been shown to reflect loading history in some way, it is unclear to what extent they respond similarly to activity and to what extend they may diverge in their reflection of activity patterns.

The present study compares activity patterns that emerge from the mechanical properties of cortical and trabecular bone in the lower limb to understand potential differences between the tissues. This research is part of the After the Plague project, which revolves around a population of inmates from the Medieval hospital of St. John in Cambridge, UK. Bone morphology was here imaged using micro-CT. Trabecular architecture was characterized for selected volumes of interest in the joints, and compared with the cortical bone distribution in diaphyseal cross-sections. The results show that the reconstructed activity patterns within this population vary distinctively based on the tissue used for the analysis.

This study provides one of the first analyses of similarities and differences between the activity patterns that emerge from either tissue. The divergences of observed patterns here imply that trabecular and cortical bone respond differently to mechanical loading. This shows that a better understanding of differences in their adaptive capacities is essential.

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Crisis or deviation?: The Erie County Poorhouse (1828-1926) as a heterotopia

JENNIFER L. MULLER[1], JENNIFER F. BYRNES[2] and DAVID A. INGLEMAN[3]

[1]Department of Anthropology, Ithaca College, [2]Division of Social Sciences, University of Hawai'i–West O'ahu, [3]Department of Anthropology, University of California, Santa Cruz

In the 19th century, American society institutionalized structural violence through the development of the poorhouse. These institutions reduced the visibility of structural violence to mainstream society by physically removing people who were poor and/or disabled from major urban centers. We argue that poorhouses may be understood as "heterotopias," which Foucault described as real places that are like societal counter-sites that are not freely accessible. Foucault distinguished two types of heterotopias. "Heterotopias of crisis," common in pre-modern societies, were places for people who experienced temporary crisis. With industrialization, poverty and disability became crises. In response, municipalities provided material support to people who were poor and/or disabled, which transformed households into heterotopias of crisis. In the early to mid-19th century, municipalities established poorhouses for individuals as well as entire families who were experiencing what was presumed to be a temporary crisis. "Heterotopias of deviation" were spaces where modern societies placed behaviorally deviant individuals. Mid- to late-19th century poorhouses functioned as heterotopias of crisis and/or deviation, depending on a person's social identity. By the late-19th to early 20th centuries, poorhouses had transitioned to heterotopias of deviation for people whom the state identified as unredeemable. We suggest that American society's development of poorhouses as heterotopias of deviation intensified structural violence against people who were poor and/or disabled. We illustrate this societal transformation with diachronic analysis of documentary and bioarchaeological data from the 19th to early 20th century Erie County Poorhouse, including analyses of the skeletal remains of 376 people.

Male mating competition and sexual dimorphism in the duration of effective breeding in wild chimpanzees

MARTIN N. MULLER[1], MELISSA EMERY THOMPSON[1], BEATRICE H. HAHN[2], KEVIN E. LANGERGRABER[3], ERIK J. SCULLY[4], LINDA VIGILANT[5], RICHARD W. WRANGHAM[4], EMILY E. WROBLEWSKI[6] and ANNE E. PUSEY[7]

[1]Anthropology, University of New Mexico, [2]Perelman School of Medicine, University of Pennsylvania, [3]School of Human Evolution and Social Change, Arizona State University, [4]Human Evolutionary Biology, Harvard University, [5]Primatology, Max Planck Institute for Evolutionary Anthropology, [6]Anthropology, Washington University in St. Louis, [7]Evolutionary Anthropology, Duke University

Across vertebrates, species with intense male mating competition and high levels of sexual dimorphism in body size generally exhibit a shorter male duration of effective breeding (DEB). Compared to females, males show later ages at first reproduction and earlier reproductive senescence because they (1) take longer to attain adult body size/musculature, and (2) can maintain peak condition for a limited time. Characterizing male fertility schedules requires genetic paternity analyses, however, which have only recently been completed for reasonable samples of wild chimpanzees. Here we present comparative genetic and demographic data from three long-term field sites (Kanyawara: Kibale National Park, Uganda; Mitumba and Kasekela: Gombe National Park, Tanzania), comprising >600 male risk years and 114 infants, to characterize age-specific male fertility. Consistent with the predictions above, males showed a shorter DEB than females. However, this was due to earlier reproductive senescence in males, rather than a later age at first reproduction. Male fertility peaked at ages 17-18, and showed a steady decline until age 40, after which few males reproduced. The youngest age of male reproduction was 10, and the oldest 51. Although male fertility peaked at the same age as muscle development, adolescent males successfully reproduced by targeting nulliparous females, who were less likely to be guarded by adults. The sex difference in age specific fertility was less than in species with higher levels of body-size dimorphism, such as some baboons and macaques, but substantially greater than in human foragers. This is consistent with the importance of pair-bonding in humans.

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Epigenetics, gene expression and the intergenerational effects of stress in mothers and offspring in the Democratic Republic of Congo

CONNIE J. MULLIGAN

Anthropology, University of Florida, Genetics Institute, University of Florida

According to the developmental origins of health and disease hypothesis, early life exposure to stress has important consequences for later life health. Epigenetically-determined changes in gene expression may be one mechanism that mediates this effect. My colleagues and I work in the eastern Democratic Republic of Congo, where 20 years of conflict and post-conflict unrest have subjected women to extreme stress and sexual violence. Blood and placental samples, plus follow-up offspring samples up to four years of age, as well as culturally-relevant data on maternal stress have been collected from three cohorts of mother-newborn dyads (2010/n=25; 2013/n=103, 2015/n=75). Associations between maternal stress, newborn health outcomes, and DNA methylation and gene expression profiles in mothers and their offspring have been tested.

We find that associations between DNA methylation and maternal stress differ in mothers and newborns. Mothers with high stress exposures show a genome-wide reduction in DNA methylation, suggesting that the individual who directly experiences the stress may show the greatest effect. In contrast, newborns show a more targeted, genic-based response to maternal stress, consistent with the premise that fetal response to intrauterine cues may focus on specific genes that are uniquely sensitive to environmental cues. We are beginning to investigate gene expression in combination with DNA methylation and we compare the efficacy of two RNA stabilization protocols. Our study takes a biocultural perspective to better understand how experiences of stress and violence may be translated into altered health outcomes in an intergenerational manner.

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Treponemal disease in pre-Columbian and Columbian Mexico. A Review

FELIANA MUÑOZ REYES[1], LOURDES MÁRQUEZ MORFÍN[1] and PATRICIA OLGA. HERNÁNDEZ ESPINOZA[2]

[1]PHYSICAL ANTHROPOLOGY, ESCUELA NACIONAL DE ANTROPOLOGIA E HISTORIA, [2]PHYSICAL ANTHROPOLOGY, CENTRO INAH SONORA

Historical sources provide a volume of evidence concerning the virulence and rapid spread of syphilis in Mexico after 1493, especially in Mexico City. However, skeletal material and its context constitute the basis for palaeopathological studies to unfold the origin and distribution of treponemal diseases. Yet, most lesions caused by treponemal diseases are not specific, making the diagnosis and differential diagnoses complicated. Here, we present an overview of the different social and geographical scenarios in which the disease spread across the country since the Pre-hispanic to post Columbian era, in addition to palaeopathological information available.

By evaluating published reports of pre-Columbian and Columbian treponemal disease in Mexico using the standardized approach proposed by Harper, et al. (2011), we could determine the existence of treponemal disease, as non-venereal variants, in the pre-Columbian era, but there has been no evidence of the presence of syphilis prior to 1493. Even when parish and sanitary records indicate its presence throughout the country, most reports use nonspecific indicators of infectious disease and non-standardized terminology to diagnose treponematoses, do not include information about methods used to examine the skeletal series, and do not provide photographs or radiographic images of the lesions. This hampers our effort of interpretation and comparison between treponemal lesions among osteological material.

Thus, we propose a methodological approach based on previously published studies, seeking to standardize the terminology and diagnostic criteria for the study of treponemal diseases.

New perspectives on cranial form in Euarchontoglires: A geometric morphometric study of primates and their kin

LAVANIA NAGENDRAN[1], GABRIELA A. SAN MARTIN FLORES[1], MALLORY G.I. ATELL[2], ORNELLA C. BERTRAND[1], RAJ BHAGAT[1], MADLEN M. LANG[1], SERGI LÓPEZ-TORRES[3], KEEGAN R. SELIG[1], DEVIN L. WARD[1,2], BENCE VIOLA[2] and MARY T. SILCOX[1]

[1]Anthropology, University of Toronto Scarborough, [2]Anthropology, University of Toronto St. George, [3]Roman Kozłowski Institute of Paleobiology, Polish Academy of Sciences

A recent study using geometric morphometrics sought to characterize the cranial morphospace occupied by primates, and showed that fossil specimens mostly fill gaps between extant taxa. However, this study did not include taxa outside of crown Primates.

Primates, together with Scandentia, Dermoptera, Rodentia, and Lagomorpha, belong to Euarchontoglires. Adding other euarchontoglirans (particularly stem primates) to the analysis is necessary to gain a broader understanding of cranial diversity over the course of primate evolution. Importantly, this approach will help establish if the euprimate cranial morphospace is distinct from their ancestors, and identify when major shifts in cranial form happened in euarchontogliran evolution.

To evaluate these questions, data on seventeen landmarks were collected from high-resolution microCT scans of 31 euarchontogliran crania including rodents (n=1), lagomorphs (n=2), scandentians (n=10), dermopterans (n=1), euprimates (n=15) and stem primates (n=2). These data were analyzed with principal component analyses both in combination with the published data and in isolation to generate two morphospaces in which the specimens were plotted. In both analyses, cranial diversity increased with the inclusion of additional taxa, although the relative position of euprimate species showed little change. The non-euprimate euarchontoglirans fall outside the range of euprimates with the exception of *Megaladapis*. Most non-euprimate euarchontoglirans, including the stem primates, cluster together, suggesting that they share a common, potentially primitive cranial bauplan. In contrast, scandentians broaden the range of the first principal component axis, suggesting that they are the most divergent euarchontoglirans in terms of their cranial form.

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Comparative Ontogeny of the Thoracolumbar Transition in Great Apes, Humans, and Fossil Hominins

THIERRA K. NALLEY[1], JEREMIAH E. SCOTT[1,2], CAROL V. WARD[3] and ZERESENAY ALEMSEGED[4]

[1]Dept of Medical Anatomical Sciences, Western University of Health Sciences, [2]Dept of Anthropology, Southern Illinois University-Carbondale, [3]Dept of Pathology and Anatomical Sciences, University of Missouri-Columbia, [4]Dept of Organismal Biology and Anatomy, University of Chicago

Differences in the anatomy of the adult thoracolumbar vertebral transition among extant hominoids are well-established and constitute an important framework for making inferences about posture and locomotion in fossil hominins. In contrast, little is known about the developmental bases of these differences. This lack of information poses a challenge when interpreting the morphology of juvenile hominins. In this study, we investigated ontogenetic variation in the thoracolumbar transition of extant great apes and humans (n=152) and juvenile and adult fossils attributed to *Australopithecus* (*A. afarensis*: DIK-1-1, A.L. 288-1; *A. sediba*: MH1, MH2; *A. africanus*: Sts 14, Stw 431). For each vertebra involved in the transition, we quantified functionally relevant aspects of zygapophyseal facet form: transverse curvature, orientation relative to midline, and the disparity in these variables across the thoracolumbar transition (i.e., the difference between the antepenultimate rib-bearing thoracic and the first non-rib-bearing lumbar within age groups). Among extant genera, adults of *Pan* and *Homo* exhibit the greatest disparities in facet morphology across the thoracolumbar transition and experience the most change in facet morphology during growth. However, humans achieve an adultlike configuration much earlier in development than *Pan*. *Australopithecus* has a facet transition situated one level higher than typical for either taxon at all developmental stages. However, it achieves its adult morphology early in development, like *Homo*. These data demonstrate that the developmental trajectory in australopiths was like humans, with similar patterns of axial skeletal development and perhaps functional equivalence within these hominins throughout ontogeny.

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Shape variation in artificially modified human crania from Postclassic West-central Mesoamerica

SELIM NATAHI[1], GREGORY PEREIRA[2] and PRISCILLA BAYLE[1].

[1]PACEA, University of Bordeaux, [2]ArchAm, University of Paris[1]

Mesoamerica has exhibited a wide range of artificial cranial modification (ACM) techniques and forms across space and time. The Zacapu basin, West-central Mesoamerica, has yielded a large number of human remains showing hints of such techniques. A strong decrease in the frequency of ACM has been reported at the beginning of the Postclassic period (900 – 1521 A.D.), where only few individuals still exhibit clear signs of ACM. The observation of several cranial morphological features suggests that ACM did not disappear but might have been expressed with slighter degrees, thus preventing the identification of these modifications. Here, we have investigated the extent to which ACM techniques persisted during the Postclassic period by quantifying subtle shape variations using geometric morphometrics. Fifty five individuals from the Postclassic sites of El Palacio and Malpais Prieto have been studied and 528 landmarks and semilandmarks were digitized on 3D models generated by surface scanning. Procrustes superimposition and multivariate statistics show shape differences between individuals. The first component, which accounts for allometric shape changes, displays

a morphological variation characterized by an expansion-reduction of various cranial regions consistent with a fronto-obelionic modification of the skull. It discriminates 7 individuals already identified with ACM morphoscopically but also differentiates 20 individuals showing more subtle modifications. The high variation measured in this second group raises the question of the intentionality of such modifications as well as the possible existence of various ACM techniques with moderate degrees of expression.

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Nature's Diet: Caloric Restriction and Oxidative Stress in Wild Bornean Orangutans, *Pongo pygmaues wurmbii*

DANIEL J. NAUMENKO[1,3], SHAUHIN E. ALAVI[2,3] and ERIN R. VOGEL[2,3]

[1]Anthropology, University of Colorado, Boulder, [2]Anthropology, Rutgers University, [3]The Center for Human Evolutionary Studies, Rutgers University

Studies in humans and model laboratory organisms have shown that fluctuations in caloric intake are closely linked to oxidative stress and, in turn, biological age and lifespan. Yet we know very little about how variation in caloric intake influences oxidative stress under natural ecological conditions. Orangutans, with the slowest life history of any primate, face extreme variation and unpredictability in the availability of fruit, their preferred food item, and have been shown to experience a 3-fold decrease in caloric intake during episodes of fruit scarcity. Further, seasonal man-made forest fires expose orangutans to increased amounts of smoke, which can increase oxidative stress when inhaled. We predicted that during episodes of fruit scarcity, orangutans experience decreased oxidative stress, while increased exposure to smoke would result in increased oxidative stress. We examined variation in oxidative damage in relation to caloric intake and air quality over a 2-year period at the Tuanan Orangutan Research Station in Central Kalimantan, Indonesia. We used enzyme-linked assays to determine concentrations of 8-hydroxy-2'-deoxyguanosine (8-OHdG), a biomarker of oxidative damage, and C-peptides of insulin (UCP) in urine, and extracted fire emissions data from MODIS satellites, to examine energetic balance and air quality respectively. We found seasonal caloric restriction during episodes of fruit scarcity reduces oxidative damage (UCP: $p<0.0001$, 8-OHdG: $p<0.0001$), though indicators of increased air pollution due to forest fires had no detectable effect ($p>0.05$). Our results suggest that these episodes of fruit scarcity and consequent caloric restriction confer a protective benefit against oxidative stress in wild orangutans.

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Measuring wild chimpanzee body temperature from fecal deposits

JACOB D. NEGREY[1], KEVIN E. LANGERGRABER[2] and CHERYL D. KNOTT[1]

[1]Department of Anthropology, Boston University, [2]School of Human Evolution and Social Change, Arizona State University

Body temperature (T_b) is a valuable measure of health and metabolic status in primates, and can be used for integrative analyses of behavior (e.g., to assess costs of intrasexual competition). However, data on T_b in wild great apes are scarce, as conventional measures of T_b are invasive. A largely overlooked but effective proxy for T_b is fecal temperature (T_f), the temperature of feces shortly following defecation. To assess variation and behavioral correlates of T_b, we measured T_f of wild chimpanzees (*Pan troglodytes schweinfurthii*) at Ngogo, Kibale National Park, Uganda. Between February 2016 and April 2017, we collected 101 measurements from 45 adult chimpanzees (male: n=28; female: n=15). T_f ranged from 33.4 °C to 38.9 °C. The mean was 35.8 °C. Consonant with results from Taï Forest, Côte d'Ivoire, we did not find significant effects by sex (U=972, n=101, p=0.26), age (rs=0.029, n=101, p=0.77), or ambient temperature (rs=0.038, n=87, p=0.72). However, we found a positive correlation between T_f and time of day (rs=0.27, n=101, p=0.0072). More strikingly, male T_f was higher after associating with, or having been within 50 meters of, a mating female (t=4.97, $p<0.0001$). Mean male T_f differed approximately 1.1 °C between males who had and had not associated with a mating female. Elevated male T_f perhaps results from direct male-male competition (e.g., physical aggression), which occurs at high rates in the presence of maximally tumescent, parous females. Therefore, our results indicate that T_f captures biologically meaningful variation and presents a powerful, noninvasive tool for great ape research.

Novel use of pure ultrasonic communication by a wild nocturnal primate, the Javan slow loris (*Nycticebus javanicus*)

K A I. NEKARIS[1] and DANIEL R. GEERAH[2]

[1]Nocturnal Primate Research Group, Oxford Brookes University, [2]School of Biosciences, Cardiff University

Among primates, only prosimians (Strepsirhini and Tarsiiformes) are known to use ultrasonic vocalisations (those ≥ 20 kHz) to communicate. The extent and causes of this form of communication remains poorly understood. In this study of the Javan slow loris (*Nycticebus javanicus*), we present the first description of purely ultrasonic calls in the family Lorisidae, and the first recordings of ultrasonic primate calls in a completely wild setting using active acoustic recording techniques. We used a Wildlife Acoustics Echo Meter EM3+ digital ultrasonic recorder and external ultrasonic microphone to record 14 individuals (t = 552 hours) throughout their active period (1700 – 0600 hrs) from November 2015 to May 2016. We identified just one type of ultrasonic call in Javan slow lorises, with both sexes and all age groups producing the call (n=791, $\bar{X}$=46.0 kHz). Here, we define its acoustic and temporal structure and hypothesise about its function and evolutionary origin. We ran Discriminant Function Analysis (DFA) to determine which acoustic or temporal variables from ultrasonic calls can predict individuality, sex, or age. The resulting DFA found intra-doublet duration and doublet click duration as the most important parameters for both classes. We suggest the call is a cryptic contact call made above the hearing range of many potential and historic predators, increasing the survival rates of parked infants. Finally, we discuss its potential for maintaining social group cohesion in fragmented environments and future directions for ultrasonic primate communication research.

Mohamed bin-Zayed Species Conservation Fund, Henry Doorly Zoo, National Geographic, People's Trust for Endangered Species, Conservation International Primate Action Fund, Cleveland Zoological Society and Metroparks Zoo, Columbus Zoo to Nekaris.

Tuberculosis and the Decline of the Wari Empire

ELIZABETH A. NELSON[1,2], ADITYA K. LANKAPALLI[1], MARIA SPYROU[1,2], ÅSHILD VÅGENE[1,2], ALEXANDER HERBIG[1], TIFFINY A. TUNG[3] and KIRSTEN I. BOS[1]

[1]Department of Archaeogenetics, Max Planck Institute for the Science of Human History, [2]Naturwissenschaftliche Archäologie, Eberhard Karls Universität Tübingen, [3]Department of Anthropology, Vanderbilt University

Mycobacterium tuberculosis (MTB) in the pre-contact New World has been the subject of intensive investigation within archaeological sciences. In 2014, recovery of pre-contact MTB genomes from Late Intermediate period (LIP) coastal Peruvian human material revealed circulation of a TB strain adapted for pinnipeds, suggesting transmission of the bacteria between seals and humans. In this study, we investigate how the decline of the Wari Empire ca. 1000 CE and a subsequent period of drought and sociopolitical change structured morbidity profiles for those in the former Wari heartland. In particular, we test for the presence of TB in Terminal Wari (ca. 1050 CE) and post-Wari (ca. 1300 CE) populations from the site of Huari—the former capital

of the Wari Empire located in the central highland Andes of Peru.

Using novel methods of initial detection based non-enriched DNA analysis followed by in-solution capture, we identified Mycobacterium Tuberculosis Complex (MTBC) DNA in LIP individuals, and reconstructed MTBC genomes from four individuals. Phylogenetic analysis revealed a pinniped strain closely related to the coastal Peruvian strains.

We present our phylogenetic analysis of the Huari strain and discuss directions for our research in investigating the spread and transmission of MTB in pre-contact Peru. This research affords us the opportunity to have a greater understanding of the geographic range of MTB infection during the pre-contact era and explores plausible explanations for the spread of MTB from the time of Wari decline to just before the Inka Empire.

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Under State Control: Scarcity, Child Growth, and Life Trajectories

ROBIN G. NELSON

Anthropology, Santa Clara University

Analyses of population-level differences in adult health outcomes often focus on broad metrics of well-being including income, household resources, and educational attainment. Embedded in these discussions are beliefs about individual lifestyle choices. Findings from studies in human biology underscore the importance of transgenerational environmental stability for the transmission of appropriate cues regarding nutrition, growth, and development. Relatedly, attachment theory suggests that deprivation and trauma during childhood can lead to persistent negative changes in both behavior and the physiological stress response. Using original data collected from 225 children living in state-regulated children's homes and familial homes in Jamaica, and comparative data from Eastern Europe and Sub-Saharan Africa, I examine the ways that scarcity during childhood impacts individual behavioral health choices due to limited social and financial capital, and psychological trauma. Additionally, these experiences increase the likelihood of altered growth patterns and negative long-term health outcomes in adulthood. With these data as the situational frame, I interrogate political narratives directed towards middle-income majority black countries regarding agency and choice at both the individual and national level. Directives encouraging better individual behavior often obscure the multiple layers, ranging from household to the nation, at which resource deprivation limits one's ability to produce optimal health outcomes.

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Eyes without a Face: Ontogeny of Orbit Orientation in Primates

EMILY M. NETT[1] and MATTHEW J. RAVOSA[1,2,3,4]

[1]Department of Biological Sciences, University of Notre Dame, [2]Department of Aerospace and Mechanical Engineering, University of Notre Dame, [3]Department of Anthropology, University of Notre Dame, [4]Department of Zoology, Divison of Mammals, Field Museum

Orbit orientation in primates is posited to result from adaptive factors related to activity pattern and allometric influences on orbit position. Although differences in circumorbital form between anthropoids and strepsirrhines have been linked to interspecific disparities in levels of orbital convergence and orbital frontation, there is considerable overlap in convergence between suborders. Unfortunately, putative links between convergence and frontation across primates, and consequent arguments about anthropoid origins, are likely to be influenced by allometry, the size range of the respective samples, and adaptive influences on encephalization and activity patterns. Indeed, such a multifarious system is less amenable to interspecific treatment across higher-level clades. Arguably, an ontogenetic perspective is one way to evaluate transformations from one character state to another, especially as they pertain to allometric effects on phenotypic variation.

We characterized the ontogeny of orbital convergence and orbital frontation in 13 anthropoid and strepsirrhine species. Correlation and regression analyses were used to test hypotheses regarding the structural and adaptive bases of variation in orbital orientation. Growth trajectories were analyzed intraspecifically and interspecifically. While orbital frontation decreased postnatally in all primates due to the negative scaling of brain size, taxic differences in the relative amount of frontation were related to corresponding ontogenetic transpositions in encephalization that varied within, and especially, between suborders. Intraspecific increases in orbital convergence were restricted to strepsirrhines, whereas anthropoids exhibit elevated levels of convergence that varied little during growth. Such comparisons increase our understanding of morphological variation in the circumorbital region that impact characterizations of primate evolution.

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Measures of Health and Disease Associated with Purifying Selection in *UCP1*

LISA NEVELL

Anthropology, Boston University

Uncoupling Protein 1 (UCP1) plays an essential role in non-shivering thermogenesis (NST). Purifying selection (not neutral conditions) are reported in human populations living in warm climates. This paper tests the hypothesis that *UCP1* may have NST independent roles which are the target of purifying selection. Sequence data for *UCP1* are obtained from the 1000 genomes project and GRCh37 version of the ensemble human reference genome. This study includes 26 samples (N=3600) representing populations from Africa, Asia, Europe, and the Americas analyzed using VCFTools. The study includes socioeconomic data, measures of health and disease from 235 countries representing Africa, Asia, Europe, and the Americas. There is a positive correlation between *UCP1* Tajima's D score and life expectancy (Pearson's correlation 0.621: p=0.000). In other words, countries with a stronger purifying selection signal in the *UCP1* genomic locus tend to have shorter life expectancy. The relationship between *UCP1* genomic variation and variation in life expectancy is nearly eliminated if you control for the rate of infant mortality (Pearson's correlation 0.168; p=0.030). Infants do not regulate temperature as efficiently as adults and rely heavily on NST to prevent hypothermia. Purifying selection in *UCP1* is associated with high rates of infant mortality (Pearson's correlation -0.638: p=0.000) and controlling for latitude cannot eliminate that association. Purifying selection in *UCP1* genomic locus may correlate with a range of phenotypes involved in infant survival, risk of death in response to extreme temperature, life expectancy and aging phenotypes, and metabolic function.

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Within-population variation of Texas-Mexico border migrants: A comparative computational analysis

BRIANA T. NEW[1], KATE SPRADLEY[1], LARS FEHREN-SCHMITZ[2] and NICHOLAS P. HERRMANN[1]

[1]Anthropology, Texas State University, [2]Anthropology, University of California, Santa Cruz

Previous studies on human population structure have demonstrated that craniometric and genetic data from similar populations indicate similar genetic distances within and between populations. However, in the absence of requisite population samples, proxy populations are often employed to conduct these comparative analyses. Therefore, it is necessary to verify whether these analytical methods are appropriate when comparing craniometric and genetic data obtained from the same individuals. Using interlandmark distances (ILD) and short tandem repeat data (STR) obtained from a sample of 33 individuals in the Texas-Mexico migrant population, the present study utilizes computational methods to investigate within-population variation on this unique data set.

This research asks whether distance analysis methods deliver significant results when comparing craniometric and genetic data from the same individuals. Genetic distances for STR and ILD data were calculated, a Procrustes plot was generated, and a Mantel test was run to assess the correlation between the two data types. While a plot of the Procrustes results demonstrates significant overlap between data sets, the Mantel statistic produces a low correlation (r = 0.02) suggesting limited similarity between the matrix structures. Finally, the interindividual results are placed in the context of worldwide and regional variation to assess patterning and potential homogeneity present in the ILD or STR data. Challenges of this comparative research are discussed and recommendations made for future research endeavors. This research is integral for not only understanding relationships within the given sample, but understanding the relationship between the craniometric and genetic data that biological anthropologists utilize frequently.

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The detection of nicotine in prehistoric skeletal remains using high-performance liquid chromatography-tandem mass spectrometry: A preliminary study

SAVANNAH LEACH NEWELL[1] and JONATHAN A. KARTY[2]

[1]Anthropology, Indiana University, [2]Mass Spectrometry Facility, Indiana University

North American research on tobacco in prehistory has focused on residues in ceramics and pipes, paleoethnobotanical remains, and historical inferences. This project is the first to determine individual tobacco use by testing for nicotine in human skeletal remains from the Midwest. A total of 12 archaeological rib samples were taken from five Illinois sites spanning from Late Woodland (400-1050 CE) to Mississippian (1050-1400 CE) time periods. Modern samples were added to the study for comparative analysis, including rib samples from donors of Indiana University's Gross Anatomy Lab and a molar from a chronic smoker. Nicotine and cotinine, its primary metabolite, were extracted and detected using liquid chromatography-tandem mass spectrometry. Based on archaeological evidence, higher tobacco levels were expected from Mississippian than Late Woodland samples.The highest levels of nicotine and cotinine, respectively, were present in modern remains with a mean of 21.37 ng/g (3.12 ng/g); Mississippian nicotine levels had a mean of 6.07 ng/g (1.37ng/g) and Late Woodland individuals had a mean of 0.97 ng/g (1.32 ng/g). However, none of the mean differences were statistical significant. Recovery for nicotine was particularly low and inconsistent across triplicates for each individual. Relative standard deviations ranged from 47.24% to of 163.17%. Cotinine was more consistently recovered with relative standard deviations ranging from 1.19% to 59.37%. The methods presented here will be further honed in order to increase recovery and replication with the ultimate goal of broadening the evidence base for studying the ceremonial use of tobacco in prehistoric North America.

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The Expendables: Child Poverty and the Inheritance of Inequality in 19th Century England

SOPHIE NEWMAN[1,3], REBECCA GOWLAND[1], ANWEN CAFFELL[1,2] and MALIN HOLST[2]

[1]Department of Archaeology, Durham University, [2]York Osteoarchaeology Ltd, [3]Department of Archaeology, University of Sheffield

This project examines the evidence for structural violence endured by working class and pauper children in 19th century England. Bioarchaeological and historical analyses were undertaken for one rural (50 non-adults) and one urban (12 non-adults) site from Yorkshire. The rural site of Fewston revealed the first bioarchaeological evidence for pauper apprentices: children from urban workhouses who were indentured to work in textile mills. Historical records revealed that these apprentices were exposed to long hours of labour, poor diet and living conditions, and in some instances physical and sexual abuse. The removal of vulnerable children to work in factories far away from the protection/intervention of family or friends was a calculated and cynical form of structural violence. The urban site of Victoria Gate, Leeds, is representative of the very poorest slum dwellers, with skeletal analysis revealing evidence for the effects of extreme poverty on growing children. At both sites, palaeopathological analysis yielded evidence for marked growth stunting, severe dental enamel defects, active rickets, scurvy, periosteal new bone formation and specific diseases such as tuberculosis. These data also indicate the poor health status of their mothers, and the biological and social disadvantage into which these children were born. The integration of bioarchaeological and historical evidence has provided unique insights into the dire effects of stark structural inequalities. These children were expendable capital; their bodies effectively sacrificed to feed the Victorian industrial machine. Within the context of dramatically increasing child poverty in Britain today, such evidence becomes particularly prescient.

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Epigenetics and the adaptive link between diet and gene expression: the role of folate and B12 in diverse populations

HAYLEY N. NICHOLS[1], MJ MOSHER[1,2], DOMINIC D. SHUTTLEWORTH[1], JORDANNA DAVIS[1], MADISON N. MCMANUS[1] and MICHAEL H. CRAWFORD[2]

[1]Anthropology, Western Washington University, [2]Anthropology, University of Kansas

DNA methylation provides an adaptive link between diet and gene expression. The B vitamins folate (B9) and cobalamin (B12) modulate both DNA synthesis and methylation through the one-carbon metabolic pathway. Both serve as cofactors for effective functioning of the methyl transfer process. Decreased global methylation is evidenced in low folate intake, however, little is known regarding effects of folate or B12 on locus-specific methylation of adaptive metabolic genes. We examine data from two distinct populations to determine if folate or B12 intake relates to differential patterns of methylation along the leptin (*LEP*) core promoter, a gene crucial to energy homeostasis. Siberian Buryat herders (n=53) remain vulnerable to seasonal food fluctuation, while agrarian Kansas Mennonite (n=142) experience a secure yearly supply.

Despite varying nutritional patterns that indicate significant differences in folate and B12 intake, both populations had adequate amounts of B12 yet low folate intake, per FAO/WHO recommendations. However, the ratio of B12 to folate intake did not differ between populations. Protein intake was significantly correlated with B12 in Buryat only ($r=0.520/p<0.001$). Adjusting for batch, sex, age, and smoking status, we completed correlations between methylation profiles and intake of folate, B12, and their ratio. Folate alone was not significant with *LEP* methylation profiles in either population. Buryat B12 intake was significant with greater methylation percentages at three CpG sites; one of unknown function, C/EBPαTBS adipocyte maturation, and initiation of leptin synthesis ($r=0.336$; 0.344; 0.355, respectively and all $p<0.003$), suggesting population specific decreased *LEP* expression for adipogenesis to meet daily energy requirements.

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Thousand Genomes Project reveals unique Native American alleles that originated during Beringian standstill

S. D. NIEDBALSKI and J. C. LONG

Anthropology, University of New Mexico

Previous work done by our group has shown that the Thousand Genome's Mexican sample possesses over 15 thousand high frequency genetic variants, contributed by Native American ancestors. These variants are absent, or at low frequency, in all populations outside of the Americas. Here we expand our study to ask first

whether these genetic variants are found ubiquitously throughout the Americas, and second, what was the relative role of standing variation vs. new mutations in the origin of these variants.

To answer these questions, we examined seven additional populations in the Thousand Genomes dataset; two from the Americas, Colombians (N=148) and Peruvians (N=130), and five populations of recent South or East Asian origin (combined N=617). The Colombian and Peruvian samples harbored 82% of the Native American variants identified in the Mexican sample. The South and East Asian samples harbored 62% of the Native American variants. However, all of these Native American variants were at low allele frequencies (<1%) in the Asian sample.

The simplest explanation for this pattern of variation is that standing rare alleles present in the ancestral Native American population prior to the Beringian standstill played a large role in establishing the unique alleles in Native American genomes. The unique alleles, not shared with the combined Asian sample may represent mutations that arose after Native Americans split from their shared ancestor with modern Asians.

Our findings provide a historical framework for genetic variation, gene by environment interactions, and phenotypic and health related characteristics in Native Americans.

Genome-wide admixture patterns in Afro-Caribbean populations from the Lesser Antilles

MARIA A. NIEVES-COLON[1,2], ANNE C. STONE[1,3] and JADA BENN-TORRES[4]

[1]School of Human Evolution and Social Change, Arizona State University, Tempe, AZ, [2]Laboratorio de Genomica para la Biodiversidad, Unidad de Genomica Avanzada CINVESTAV, Irapuato, Guanajuato, MX, [3]Center for Evolution and Medicine, Arizona State University, Tempe, AZ, [4]Department of Anthropology, Vanderbilt University

Afro-Caribbean populations remain underrepresented in anthropological genetics research. This sampling gap precludes understanding of how the African diaspora has shaped the genomic and cultural variation of Caribbean islanders. Here we address this gap by examining high-density nuclear SNP genotypes from 55 self-identified Afro-Caribbean communities across five Lesser Antilles: St. Kitts, St. Lucia, St. Vincent, Grenada, and Trinidad. Our findings indicate that all islanders have large components of African ancestry and low proportions of Native American ancestry; a significantly different pattern from that observed among admixed Latinos from the Greater Antilles. We further found variation in admixture patterns between island communities. Trinidadian Afro-Caribbeans for instance, carry large components of East and South Asian ancestry which were likely contributed by Indian and Chinese migrants during the colonial indentureship period. In addition, comparisons of autosomal versus X-chromosome ancestry revealed a significant difference in African, European and South Asian ancestry proportions across the two genetic systems. This indicates that sex-biased mating patterns, where mostly European males reproduced with African, Native American and South Asian females, played a large role in shaping the genetic diversity of Afro-Caribbean communities in the Lesser Antilles. Overall, our findings underscore the large impact of post-colonial demographic processes in shaping the genomes of afro-descendant islanders. This work also increases the representation of admixed and diverse populations in available genomic datasets and has the potential to inform future functional and clinical genetics research with admixed Caribbean peoples.

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Functional morphology of the cervical spine in tree-gouging primates

ABIGAIL C. NISHIMURA[1] and GABRIELLE A. RUSSO[2]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [2]Department of Anthropology, Stony Brook University

Though many primates opportunistically consume tree exudates, only a few species habitually use their anterior dentition to elicit the flow of exudates. Video observation suggests a stabilizing role of the neck during this specialized tree-gouging dietary behavior, intimating that the cervical vertebral column may reflect features related to gouging. Here, we quantify cervical vertebral morphology (C1, C2, and C6) in three gouging species (*Callithrix jacchus, Cebuella pygmaea,* and *Euoticus elegantulus*) and nine nongouging species of marmosets, tamarins, and galagos to test functional hypotheses related to dietary behaviors. Morphological predictions were developed based on the functional hypotheses that gougers would exhibit specific vertebral features related to (1) decreased intervertebral mobility and (2) increased muscle force generation potential in the cervical region. Forty-three size-adjusted linear metrics and angles were captured using digital calipers and standardized photographic methods. Differences between gouging and nongouging groups were analyzed using phylogenetic analyses of variance. Compared with nongougers, gougers had significantly craniocaudally longer C6 transverse process anterior tubercles, as predicted. In contrast to predictions, gougers also had smaller C1 anterior arch cross-sectional areas and smaller C1 anterior tubercle cross-sectional areas. These results may relate to the distinct functional roles of the cranial and caudal cervical vertebral levels. This work provides insight into previously unexplored links between dietary behaviors and primate neck morphologies.

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Multi-Isotope Analysis to Reconstruct Dietary and Migration Patterns of an Avar Population from Sajópetri, Hungary, AD 568-895

LIOTTA NOCHE-DOWDY[1], ROBERT H. TYKOT[1], GEORGE D. KAMENOV[2] and ERIN H. KIMMERLE[1]

[1]Anthropology, University of South Florida, [2]Geological Sciences, University of Florida

The Avars were nomadic people from Central Asia who migrated into the Carpathian Basin in Central-Eastern Europe during the mid to late Migration Period (AD 568 – 895). Archaeological evaluation of grave goods and documentation of mortuary practices have been the primary means of understanding the Avars. However, this approach has largely neglected skeletal and biochemical analysis, in particular as these approaches relate to the biological variation, ancestry, and dietary patterns of the Avars.

There remains debate as to whether disparities existed among the socially stratified Avar population of ancient Hungary and if disparities were the result of differential access to nutritional resources. This hypothesis was tested by utilizing isotopic analyses in conjunction with qualitative analyses of grave goods.

Multi-isotopic analyses of stable isotopes carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and oxygen ($\delta^{18}O$), and the heavy isotopes strontium ($^{87}Sr/^{86}Sr$) and lead ($^{206}Pb/^{204}Pb$) were selected for this research. The analysis was performed on samples derived from tooth enamel and bones of (n=27) individuals.

The stable isotope values revealed some differences between the sexes, but not a significant amount of variation between the social classes. The heavy isotope values revealed a considerable amount of variation compared to known values for the region, thus showing a more recent migration to the region than expected. Reconstructing migration and dietary patterns using isotopic analysis of Avar remains at the Sajópetri cemetery site has helped estimate variability among social groups and between sexes in this population during the Migration Period.

Associations of Fitzpatrick Skin Type with Skin M Index in Diverse Populations

HEATHER L. NORTON[1], LINDSAY FIST[1] and ESTEBAN J. PARRA[2]

[1]Anthropology, University of Cincinnati, [2]Anthropology, University of Toronto, Mississauga

The Fitzpatrick Skin Type (FST) Classification Scale is a standard tool used for self-assessment of sun-sensitivity. Originally developed for use with lightly-pigmented individuals, it has been extended to apply to a broad range of pigmentation levels. However, there is growing evidence that it may not accurately capture information about skin color and sensitivity in more darkly pigmented individuals, possibly due to bias in how FST questions are worded and/or because of differences in genetic pathways associated with constitutive skin pigmentation and tanning response. We compare quantitative measurements of skin color (M index) and self-assessments of FST in individuals who self-identify as African American (n=189), Hispanic (n=81), or European-American (n=213) to evaluate how accurately self-reported FST reflects constitutive skin pigmentation. ANOVA was conducted to compare mean skin M between these population samples in each FST category. There were significant differences in mean skin M index in FST categories III ($F=21.61$, $df=2$, $p<0.0001$), IV ($F=122.6$, $df=2$, $p<0.0001$), and V ($F=28.94$, $df=2$, $p<0.0001$). In all cases post-hoc tests showed that these differences were driven by higher skin M values between the African American and other two samples ($p < 0.001$ for all comparisons). No significant differences in skin M were observed between the European and Hispanic samples in any of the FST categories. This suggests that self-assessed FST may not be an accurate predictor of skin color in at least some populations, a fact that has implications for studies of pigmentation variation as well as for melanoma risk assessment in diverse populations.

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Environmental Reconstruction at Geelwal Karoo

ALEXANDRA L. NORWOOD[1] and KAYE REED[2]

[1]Department of Anthropology, University of Michigan, [2]Institute of Human Origins and School of Human Evolution and Social Change, Arizona State University

Geelwal Karoo (GK) is a fossil site located on the western coast of South Africa that is currently on the border between the fynbos and succulent karoo vegetation zones. GK was likely deposited during a glacial period in the last 100,000 years, based on the FADs and LADs of the recovered fauna. We excavated the locality in 2015, and note that it is in an area where stone hand-axes are also present. It has been hypothesized that that fynbos vegetation has been in place in the Western Cape region for the last 5 million years. This would mean that *Homo erectus* and early modern humans, who were present in the region from about 500 Ka, foraged in the fynbos habitat. We examined this hypothesis by first identifying the mammalian species from GK, and then using species distribution models (SDM) of the extant species recovered, and performing correspondence analysis (CA) of their dietary and locomotor adaptations in conjunction with 241 modern mammal communities in which these adaptations were known. SDM shows that most of these mammal species overlap in range today in central Botswana, near Lake Ngami on the outskirts of the Okavango Delta— likely where the habitat at the time of deposition was most similar. The CA shows that GK does not group with other modern fynbos localities, but is more similar to open grasslands, challenging the hypothesis of the stability and antiquity of the fynbos in this area.

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Tracing the victims of the 16th/17th century plagues in western Istria - bioarchaeological analysis of a mass grave from Umag

MARIO NOVAK[1], IVOR JANKOVIC[1], BRANKA MILOSEVIC[2] and ANIKA MIJANOVIC[3]

[1]Department for Scientific Research, Institute for Anthropological Research, Zagreb, [2]Museum of Croatian Archaeological Monuments, Split, Museum of Croatian Archaeological Monuments, Split, [3]Department of Archaeology, Umag Town Museum, Umag

Umag is a medieval town located on the western coast of the Istrian Peninsula in Croatia. According to the historic sources, numerous outbreaks of bubonic plague took place in the region between the 15th and 17th centuries. Probably the most devastating epidemic was the one that originated in Venice in 1630. The effect on the population of Umag was devastating, as sources state that the number of inhabitants was cut down by half at the end of the outbreak.

During the 2016 rescue excavation in the town centre, a mass grave with the remains of at least 32 individuals was discovered. The burial is dated to the 16th/17th century based on the recovered artefacts and horizontal stratigraphy. The human remains were mostly commingled and covered with a thick layer of lime. The sample includes both sexes and all age groups: the youngest individual was a neonate, while the oldest was over 50 years of age. A whole range of pathologies are present, including caries and AMTL, antemortem fractures, cribra orbitalia, degenerative joint diseases, and DISH.

The location of the burial outside of the medieval town walls close to the church of St. Rocco, the patron saint against plague, as well as the context (mass grave covered with a thick layer of lime) strongly suggest this was a burial place for plague victims. Hopefully, this hypothesis will be soon confirmed by the results of aDNA analysis that is in progress.

Bioarchaeology Beyond Structure: Discussing Power and Inequality Through the Lens of Practice

SELIN E. NUGENT[1] and KELLEN N. HOPE[2]

[1]Institute for the Study of the Ancient World, New York University, [2]Museum Studies Department, George Washington University

Decades of bioarchaeological research has shed light on the diverse and widespread experiences with the economic, political, and ideological inequalities embodied in the human remains of past societies. These endeavors have been well-positioned to address power dynamics in social systems that may not be evident or accurately represented in the historical record or through material culture. However, broader discussions of social systems often reflect an antagonistic relationship between the individual/group and structural forces. We argue for the integration of perspectives from practice, post-colonialist, and feminist theories, which recognize individual and group decisions in reproducing, transforming, and resisting the political and economic conditions of power. As a case study, we examine the representations of power dynamics during the emergence of increasingly stratified societies in the South Caucasus during the 3rd millennium BC. Isotopic analysis of populations from complex settlement sites for mobility and diet reveals complex processes in forming community identity around shared subsistence and mobility practices. Individual life courses in context with social relationships represented in funerary contexts reflect efforts in promoting social cohesion. Conclusions from this study highlight how the examination of individual life histories and group dynamics offer greater interpretive power in examining how human populations engage and interact with social systems.

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Early Pleistocene grassland evolution at East Turkana, northern Kenya, as indicated by shifting patterns of mesic and xeric adapted mammals

KAEDAN O'BRIEN[1,2], AMANDA MCGROSKY[2,3], KAYLA ALLEN[2,4], LAUREN ANDERSON[2,5], MARYSE BIERNAT[2,3], DAVID R. BRAUN[2,5,6,7], AMANDA "BILLIE" GUERRERO[2,8], ASHLEY HAMMOND[2,5,9], LAURA HUNTER[10,2], JEFFREY SECKINGER[2], FELIPE TORRES[11,2], R. BRENDON ZELLER[2,4], DAVID B. PATTERSON[2,4,5] and DEGSEW ZERIHUN[12,2]

[1]Anthropology and Integrative Biology, University of Wisconsin-Madison, [2]Koobi Fora Research and Training Program, The George Washington University, [3]School of Human Evolution and Social Change and Institute of Human Origins, Arizona State University, [4]Biology, University of North Georgia, [5]Center for the Advanced Study of Human

Paleobiology and Anthropology, The George Washington University, [6]Archaeology, University of Cape Town, [7]Human Evolution, Max Planck Institute for Evolutionary Anthropology, [8]Anthropology, University of La Verne, [9]Human Origins Program, Department of Anthropology, National Museum of Natural History, [10]Ecology, Evolution, and Environmental Blology, Columbia University, [11]Instituto de Ciencas de la Tierra, Universidad Austral de Chile, University of Chile, [12]Archaeology, Addis Ababa University

Extensive evidence for the evolution of *Paranthropus* and early members of the genus *Homo* can be found at East Turkana in northern Kenya. However, the complex dynamics of the ecosystems inhabited by these hominins remain somewhat unclear. To determine paleoecological changes between 2-1.4 Ma, faunal abundance analyses were conducted using data from the Turkana Basin Paleontology Database, the Turkana Basin Institute Paleontology Database, and new field collections. The relative proportions of xeric- and mesic-adapted ungulate taxa were analyzed across space during the Upper Burgi, KBS and Okote members at East Turkana, representing much of the early Pleistocene. We find that only the Karari subregion experienced statistically significant faunal turnover during this period, primarily between the Upper Burgi and KBS members. This turnover indicates aridification during the recession of Lake Lorenyang, as dominant mesic taxa were replaced with xeric taxa. Intriguingly, the ecologically-puzzling suid genus *Kolpochoerus* follows the same abundance pattern as the bovid tribe Reduncini, supporting existing assertions that these suids were mesic-adapted in the region and possibly throughout the continent, and may be used as an ecologically indicative taxon. The Karari subregion has a high frequency of known archaeological localities dated to this time period, suggesting hominins were inhabiting these xeric habitats. Further analyses are needed to understand the relationship between habitat heterogeneity, hominin behavior, and sources of stone to make tools.

Social party initiation, maintenance, and affiliative interaction by adolescent female orangutans in Gunung Palung National Park, West Kalimantan, Indonesia

CAITLIN A. O'CONNELL and CHERYL KNOTT

Anthropology, Boston University

In an effort to understand orangutan sociality and the benefits of socializing for a semi-solitary ape, we explore the social lives of the most gregarious orangutan age-sex class - adolescent females. From 1994-2016 adolescent females in Gunung Palung National Park had a social encounter on 50% of their follow days, spending 31% of their time in the company of others. Adolescent females were responsible for initiating social parties (coming within 50 meters) with other age-sex classes 86% of the time. Once they were in a social party, the percentage of approaches (decreases in distance between individuals) performed by adolescent females was significantly predicted by the age-sex class of their social partner ($F=4.086$, $p=0.02$). Adolescent females performed most of the approaches when they associated with adult females (70%), while approaches were more equal when they associated with flanged males (46% performed by adolescent females) or unflanged males (56% performed by adolescent females). These findings, in combination with higher rates of agonistic interactions between adolescent and adult females and higher rates of affiliative behaviors between adolescent females and unflanged males, indicate that adolescent females actively seek social opportunities with all age-sex classes, but the benefits and risks associated with socializing vary based on the age-sex of their social partners. We argue that sociality is important during adolescence for female orangutans because they must establish themselves in the social landscape, and must seek social learning opportunities. Finally, we consider the adaptive significance of meaningful social bonds for a semi-solitary, sexually coercive ape.

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Patterns of Osteoarthritis in an Early-Agricultural Society: Relationship with Growth and Stature

DARCI J. ODOM

Sociology, Anthropology, and Social Work, Texas Tech University

Osteoarthritis (OA) is one of the most common pathological conditions seen in archaeological skeletal collections. The goal of this study is to identify the patterns of osteoarthritis in the peripheral joints of a skeletal sample from the Norris Farms 36 archaeological collection in the Central Illinois river valley. To date this disease is under examined, specifically in this subsistence group. This study utilized a sample of 78 individuals, 47 females and 31 males, with estimated ages greater than 20 years old. The population associated with the cemetery is known to be transitional between hunting-gathering and agriculture, therefore it is important to identify the frequency and severity of this disease in order to raise the understanding of underlying etiologies behind it. Better knowledge of the association between growth/stature and joint disease needs to be established in past peoples in order to gain perspective on contemporary cases. The results of this study indicate that severity of osteoarthritis increases in a linear fashion with age, as expected. Unlike other past populations, males and females do not differ significantly in the severity of osteoarthritis. Additionally, the sample revealed a slight association between the tallest females and severe arthritis, which could potentially be linked to a genetic factor, Growth and Differentiation Factor 5 (GDF5). Finally, there is a positive correlation between tibia length (knee height) and the severity of knee arthritis for females in the sample that warrants further research into the biomechanics of the knee joint and the onset of OA.

Meat eating frequencies in wild chimpanzees - The effect of absolute meat amounts, hunt participation and female reproductive state on the $\delta^{15}N$ ratios of hair

VICKY M. OELZE[1,2], ROMAN M. WITTIG[2,3], SYLVAIN LEMOINE[2], HJALMAR S. KUEHL[2] and CHRISTOPHE BOESCH[2]

[1]Anthropology Department, University of California Santa Cruz, [2]Department of Primatology, Max Planck Institute for Evolutionary Anthropology, [3]Taï Chimpanzee Project, CSRS

We know that the roots of hunting and meat eating lie deep in our shared evolutionary past with chimpanzees (*Pan troglodytes*). Expanding our knowledge of chimpanzee meat eating variability in the wild requires non-invasive and indirect quantitative data on meat eating. We here validate the use of stable isotope analysis in shed hair to reconstruct meat eating behavior, by analyzing a new extensive isotope dataset (n=268) of chimpanzees from Taï forest (Côte d'Ivoire) and relating it to observed amounts of eaten meat, as well as age, sex, reproductive state and hunting participation, while controlling for group, individual differences and differences in observation time.

We collected hair from fresh nest of 27 known individuals from two communities, right after six months of detailed meat eating data recordings were completed. Meat eating amounts were estimated based on prey body parts, their respective weight for different primate taxa, sex and age classes. These estimates resulted in significant differences in meat amounts eaten by chimpanzees. Hunting activity varied strongly between groups (20 vs. 3 hunts). Meat amounts correlate with participation observed in hunts, with three impact hunting males consuming 15 - 25kg of meat during the six month study, whereas the average was 3.8kg. The isotope signatures, particularly in $\delta^{15}N$, relate to these large differences, but suggest that not only amount of meat, but also sex (reproductive state of females) play a role in $\delta^{15}N$ signatures of hair, which should find increasing consideration in future studies using isotopes in wild primates.

Accurately reconstructing crown heights of anterior teeth using micro-computed tomographic scans of fossil teeth

MACKIE O'HARA[1], ADELINE LE CABEC[2], SONG XING[3], MARK F. SKINNER[4] and DEBBIE GUATELLI-STEINBERG[1]

[1]Department of Anthropology, The Ohio State University, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [3]Key Laboratory of Vertebrate Evolution and Human Origins of the Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, [4]Department of Archaeology, King's Manor, University of York

Accurate reconstructions of crown height from partially worn teeth play an important role in studies of dental growth and development in paleoanthropology and bioarcheology. Such reconstructions have previously been achieved for canines using Adobe Photoshop to extend mesial/distal sides of the cusp tip from labial view or labial/lingual sides from sagittal view (thin sections). Here, we show that this technique can be used to accurately and non-destructively reconstruct canines and incisors (which cannot be reconstructed from facial view) using µ-CT scans of teeth. We digitally reconstructed artificially worn (cropped) crowns on 2D standardized developmental sections from µCT scans. Crown heights were measured on 2D digital sections of practically unworn *Homo naledi* mandibular canines (n=5), maxillary canines (n=3), mandibular lateral incisors (n=1), and maxillary lateral incisors (n=3). Cusp tips were digitally cropped to represent different wear patterns. Each cropped cusp was digitally reconstructed and measured by each author three times. Percent error for the reconstructions was low, averaging 0.30%, with low intra- and inter-observer error. ANOVA analysis revealed no significant effects for the crop type or the author doing the reconstruction. Significant effects were found for tooth type, with mandibular teeth showing less error. Results indicate that this method of reconstructing crown heights on µCT scans is accurate, though accuracy varies by tooth type. This is the first time the method has been attempted and validated non-destructively for incisors. This method can be used in studies of growth and development as well as studies of 2D enamel thickness using µCT data.

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Tiwanaku affiliation and quality of life in Middle Horizon San Pedro de Atacama, Chile

LEIGH OLDERSHAW[1], MARK HUBBE[1,2], CHRISTINA TORRES-ROUFF[2,3] and SHARON SADVARI[1]

[1]Anthropology, The Ohio State University, [2]Instituto de Arqueología y Antropología, Universidad Católica del Norte, [3]Anthropology, University of California, Merced

Recent studies suggest that the people of the San Pedro de Atacama oases in Northern Chile engaged in a complex relationship with the Tiwanaku polity during the Middle Horizon (AD 400-1000). On a regional level, this relationship may have lead to the use of Tiwanaku offerings as prestige items. As it is likely that each *ayllu* (kin based community structure) experienced a different relationship with the Tiwanaku, regional studies may be missing social complexity present within the region. Here, we address this limitation by testing the hypothesis that social complexity and access to resources varied by *ayllu*, and that this variation was related to the degree of interaction each *ayllu* had with the Tiwanaku polity. We do this by analyzing 239 burials associated with two Middle Horizon *ayllus* (Quitor: N=150, Solcor: N=89). Individuals associated with each ayllu were evaluated based on diet (antemortem tooth loss, which has been linked to corn consumption; corn is a high value food in this context), trauma, cranial modification, and origin of mortuary goods (Tiwanaku, non-Tiwanaku foreign, or local). Chi-square tests and correspondence analyses were performed to assess differences between *ayllus*. Results indicate that Solcor has significantly more Tiwanaku grave goods (p=0.00125), higher rates of antemortem tooth loss (p<0.0001), lower rates of trauma (p=0.03625), and more sex-based equity than Quitor. These findings support the idea that Tiwanaku influence differed by ayllu and moreover, suggest that there was significant variability between neighboring ayllus in access to resources and prestige goods.

Large mammal community structure and habitat variability in eastern and southern African *Paranthropus* and *Australopithecus*

KELSEY D. O'NEILL and AMY L. RECTOR

Anthropology, School of World Studies, Virginia Commonwealth University

Eastern and southern *Paranthropus* and *Australopithecus* overlapped temporally, but differed in geographic distributions and potential niche occupation. Isotope and microwear data suggests that congeners relied on variable diets. Here, we apply large mammal community analyses to assess habitat variability and seasonality used by eastern and southern African robust and gracile hominins.

To compare paleoecological contexts, associated assemblages of large mammals from >30 southern and eastern African *Paranthropus* and *Australopithecus* sites were analyzed using a community approach. Multivariate correspondence analyses compared fossil communities to 191 extant communities in modern African habitats. The modern African sample includes abiotic variables such as mean annual temperature and seasonality and precipitation seasonality. Using presence/absence data of 243 extant large mammal species and their locomotor and dietary adaptations, modern communities were described in terms of abiotic data, and this variability was used to retrodict community affinities for plio-pleistocene hominins.

Multivariate analyses suggest that large mammal communities associated with *P. robustus* and *P. boisei* were most ecologically similar to those of modern seasonal grasslands. While *P. boisei* sites were likely wetter over the course of the year, *P. robustus* sites were more influenced by seasonality in temperature and rainfall. The difference would have affected resource availability for both species. Compared to paranthropith ecology, eastern and southern australopith paleoecology reflects more variation in seasonality and paleohabitat. Large mammal communities associated with *A. afarensis,* for example, differ in bovid tribe distribution, suggesting that the gracile hominins existed in multiple habitats varying in seasonality.

Global Phylogeography of *Mycobacterium Tuberculosis* Reveals Role of Recent Human History in Pathogen Dispersal

MARY B. O'NEILL[1,2,3], ANDREW KITCHEN[4], ALEX ZARLEY[5], WILLIAM AYLWARD[6], VEGARD ELDHOLM[7] and CAITLIN S. PEPPERELL[2,8]

[1]Laboratory of Genetics, University of Wisconsin, [2]Department of Medical Microbiology and Immunology, University of Wisconsin, [3]Laboratory of Human Evolutionary Genetics, Institut Pasteur, [4]Department of Anthropology, University of Iowa, [5]Department of Geography, University of Wisconsin, [6]Department of Classical and Ancient Near Eastern Studies, University of Wisconsin, [7]Infection Control and Environmental Health, Norwegian Institute of Public Health, [8]Department of Medicine, University of Wisconsin

Tuberculosis (TB) is the leading cause of death due to an infectious disease worldwide, having recently surpassed HIV/AIDS. The causative agent of TB, *Mycobacterium tuberculosis* (*M.tb*), can be divided into seven genetic lineages whose spatial distributions have been hypothesized to reflect the ancient population movements of humans as they emerged from Africa. However, recent estimates of *M.tb* evolutionary rates suggest that *M.tb* genetic diversity is too recently derived to reflect such ancient events. For example, previous research has shown that *M.tb* populations in the Americas bear the imprint of European colonial migration, and that circulating *M.tb* strains were introduced by European colonization and not during the initial peopling of the Americas. Here we reconstruct *M.tb* migration throughout the Old World by applying evolutionary rates calibrate with historical *M.tb* genomes. We reveal lineage-specific dispersion patterns, and link *M.tb* migration to historical trade, exploration, and altered patterns of connectivity among

Old World regions within the past few millennia. Our results reveal complex relationships between spatial dispersal and growth of *M.tb* populations, and identify the critical historical period during which the independent evolutionary trajectories of bacterial sub-populations were established that underlie the current pandemic.

Individual muscle contributions to support, progression and balance in bipedal chimpanzee and human walking

MATTHEW C. O'NEILL[1] and BRIAN R. UMBERGER[2]

[1]Department of Basic Medical Science, University of Arizona College of Medicine, [2]Department of Kinesiology, University of Massachusetts, Amherst

Over the past 40 years, a major contribution of the Stony Brook University Primate Locomotion Lab has been documenting muscle recruitment patterns (using electromyography) and ground reaction forces (using force platforms) in bipedal chimpanzee and human walking. Yet, to date, these two datasets have been mostly studied in isolation. Here, we calculate the contributions of individual pelvis and hind/lower limb muscles to vertical support, fore-aft progression and mediolateral balance over a stride in each species, providing a direct link between muscle recruitment and ground reaction force measurement in facultative and habitual bipedalism.

Marker and force platform data from bipedal chimpanzees (N=3) and humans (N=3) walking at matched dimensionless speeds were integrated with three-dimensional pelvis and hind/lower limb musculoskeletal models to calculate individual muscle forces via static optimization. An induced acceleration analysis was then performed to compute the contributions of each of these muscles to the vertical, fore-aft and mediolateral ground reaction forces.

Unlike humans, bipedal chimpanzees use their gluteus maximus ischiofemoralis and quadriceps femoris muscles for vertical support, fore-aft progression and mediolateral balance. However, in both species, the plantarflexors play significant roles in vertical support and fore-aft progression. These data provide a direct link between muscle recruitment patterns and ground reaction forces, and a better understanding of the function of individual muscles in both facultative and habitual bipedal walking overall.

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Population genomics of white faced capuchin monkeys (Cebus capucinus imitator) with unbiased fecal genomes

JOSEPH D. ORKIN[1,2], MICHAEL J. MONTAGUE[3], AOIFIE DOHERTY[4], J. PEDRO MAGALHAES[4], WESLEY C. WARREN[5], SHOJI KAWAMURA[6], TOMAS MARQUES-BONET[7] and AMANDA D. MELIN[1,2]

[1]Anthropology and Archaeology, University of Calgary, [2]Department of Medical Genetics, Alberta Children's Hospital and Research Institute, [3]Department of Neuroscience, University of Pennsylvania, [4]Integrative Genomics of Ageing Group, Institute of Ageing and Chronic Disease, University of Liverpool, [5]McDonnell Genome Institute, Washington University in St. Louis, [6]Department of Integrated Biosciences, Graduate School of Frontier Sciences, The University of Tokyo, [7]Institute of Evolutionary Biology, CSIC-UPF, Barcelona, Catalunya, Spain

To better understand the genetic basis of gracile capuchin biology and adaptation, we report for the first time an annotated, high-coverage genome assembly of a male Costa Rican white-faced capuchin monkey, along with 10 additional genomes sequenced to high depth (15-50x coverage) from two populations of capuchins inhabiting drastically different habitats. The Cebus capucinus imitator 1.0 genome was generated from 81x (50x fragments, 26x 3kbs, and 5x 8kbs) coverage on an Illumina HiSeq 2500 instrument. The combined sequence reads were assembled using ALLPATHS-LG software, resulting in a 2.72 Gb genome with a contig N50 of 41.2 kb and scaffold N50 of 5.27 Mb. We annotated the genome with a de novo assembled transcriptome (built using Trinity software) that resulted in 37,471 genes and pseudogenes, 20,740 of which are protein-coding.

We analyze the genomes of six capuchins inhabiting the highly seasonal dry forests of Guanacaste province, and four genomes of capuchins residing near Manuel Antonio National Park, a lowland rainforest. Importantly, we describe a genome assembly for a non-model organism, and demonstrate the successful application of a new method of obtaining whole genome data from non-invasively collected field samples of low quality (feces). We focus on genes under positive selection in capuchins, and on genes that underlie sensation, cognition, and immune function due to the tendency of these genes to evolve quickly in primates, including our lineage, and other animals, and also due to their relevance to capuchin-specific biology and adaptation.

Alberta Children's Hospital and Research Institute, University of Calgary, and Washington University in St. Louis

Effect of enclosure type on locomotion and spatial use in captive sifakas (*Propithecus coquereli)*

DANIELLE R. ORLANDI[1], ROSHNA E. WUNDERLICH[1], MARK M. MCGOWAN[2] and ANTHONY TONGEN[2]

[1]Biology, James Madison University, [2]Mathematics, James Madison University

The assessment of physical activity in captive primates is important to health and husbandry decisions and to the interpretation of experimental studies. The purpose of this experiment was to assess differences in locomotor activity, energy expenditure, and spatial use during locomotion in sifakas in caged enclosures (CGEs) and natural habitat enclosures (NHEs) at the Duke Lemur Center (DLC). We hypothesized that sifakas in NHEs will exhibit more leaps/hour, higher overall dynamic body acceleration (ODBA, proxy for energy expenditure) and active time, less rest time, and greater forest height use than in the CGEs. Using a datalogging inertial sensor attached to 7 sifakas, we collected three-dimensional acceleration and barometric pressure (related to height) for a total of 81 hours in CGEs (367.5–843.5 ft^2 x 10 ft), and 170 hours in NHEs (1.5-14 acres) at the DLC. We used continuous focal animal sampling to ground-truth the acceleration data. We compared number of leaps, ODBA, activity and rest time, and barometric pressure between enclosure types. Sifakas in NHEs did not differ in spatial use ($p = 0$) but did leap less ($p=0.0008$), were less active ($p=0.02$), rested more ($p=0.02$), and exhibited lower ODBA ($p=0.006$) than those in CGEs. Our results demonstrate that activity levels can be in higher in an extensive CGE than in an NHE. Spatial usage in captive sifakas is likely influenced more by location of resources than cage size. We also demonstrate that inertial sensors provide a useful tool for quantifying locomotor behavior and energy expenditure in captive primates.

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Results of the forensic analysis performed on the child martyr of Puente Genil, Córdoba, Spain

RICARDO ORTEGA RUIZ[1], LUIS RUIZ MOLINA[2], CRISTINA GÓMEZ RÍOS[3], FÁTIMA ORTIGOSA MARTÍNEZ[1], CARMEN RODRÍGUEZ GARCÍA[1] and NOELIA MEDINA SÁNCHEZ[1]

[1]Forensic Archaeology and Anthropology, IFPCF, [2]Criminology, Independent Researcher, [3]Physical Anthropology, Independent Researcher

The present communication is focused in the investigation of the circumstances, reasons and the possible author of the kidnapping and subsequent finding of the lifeless body of Alonso Ruperto, child martyr of Puente Genil in the mountains known as "Cabeza Mesada", which took place between the dates of November 27, 1731 and January 4, 1732. At this sense, all the process has been analysed by the disciplines of criminological profiling, forensic biology and forensic anthropology.Current studies developed show the body of a child with aged between three and five years, around 1 meter height and with some feeding deficencies, mainly in iron, according to the results obtained by forensic anthropology, but he displays a considerable amount of well preserved tissues as well.The body still has part of its original clothing (mainly the trouser), some hair, skin covered by blisters and also presents

a taphonomic alteration that allows him to preserve the scalp in the form of leather. All of these organic materials have been analysed in the context of forensic biology in order to obtain more information regarding the way of life and cause of death of the individual.

The morphology of Carabelli's cusp at the enamel-dentine junction of *Australopithecus* and *Paranthropus* upper molars

ALEJANDRA ORTIZ[1], SHARA E. BAILEY[2,3], JEAN-JACQUES HUBLIN[3] and MATTHEW M. SKINNER[3,4]

[1]Institute of Human Origins, School of Human Evolution and Social Change, Arizona State University, [2]Center for the Study of Human Origins, Department of Anthropology, New York University, [3]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [4]School of Anthropology and Conservation, University of Kent

The expression of accessory cusps has long been used in hominin systematics and in reconstructing modern human population histories. One of these features, Carabelli's cusp, appears on the mesiolingual surface of hominoid upper molars. Early studies reported differences in Carabelli's cusp morphology in *Australopithecus africanus* and *Paranthropus robustus.* However, our understanding of the extent of Carabelli's cusp variation in Plio-Pleistocene hominins has been hindered by tooth wear and limitations to non-destructively visualize the dentinal contribution to expression at the outer enamel surface. This study examined Carabelli's cusp expression at the enamel-dentine junction in 116 Plio-Pleistocene hominin molars, including *A. anamensis* (n=8), *A. afarensis* (n=8), *A. africanus* (n=52), and *P. robustus* (n=48). We assessed Carabelli's cusp expression within and among species and devised a scoring system that captures this variation, which differs from standards used for recent humans. Our results reveal that Carabelli's cusp is present in high frequencies (>85%) in all hominin species examined. The strongest grades of expression were observed in *A. africanus*, the weakest grades were found in *A. anamensis and A. afarensis*. Carabelli's cusp in *P. robustus* is generally represented by a y-shaped or concave crest on the mesiolingual aspect of the protocone. A depression above the crest accompanies this structure. In addition to this crest, *A. africanus* often expresses diagonal crests forming a trapezoid-like structure on the center of the protocone. The presence of vertical furrows is also ubiquitous and appears to be the main source of variation on the lingual aspect of Plio-Pleistocene hominin molars.

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Perilous Pregnancies, Frail Bodies, and Proper Behavior: A biohistoric analysis of sexual dimorphism and the construction of sex and gender roles

LIZ ORTIZ[1], ADAM C. ZIMMER[2], PAMELA K. STONE[3] and RYAN P. HARROD[1]

[1]Anthropology, University of Alaska Anchorage, [2]Anthropology, University of Massachusetts-Amherst, [3]School of Critical Social Inquiry, Hampshire College

The construction of sex/gender is deeply rooted in the ways science, more specifically anthropology, has crafted the story. While biological differences exist in all primates, the performance of sex/gender in humans is unique. Our sex and gender identities are socioculturally constructed and historically contingent. Additionally, many of the early researchers lacked critical self-reflection, which failed to ask how these identities change and are reinterpreted through time. This project identifies how Victorian era explanations for human sexual dimorphism were hinged on developing understandings of skeletal dimorphism, and were coupled with biologically deterministic assumptions of behavior. Combined, these factors worked to support the temporally framed image of the evolved, civilized, fragile white female. This picture of the appropriate female was used as a means to argue distinct differences between our primate ancestors, girded the "great chain of being", helped to shape race science, and allowed for the universal perception of male dominance. Males were narrated as stronger and more resilient than females in all primate species. This backdrop constructs and perpetuates assumptions that sexual dimorphism equals sexual inequality. Using case examples from Europe, the American Southwest, and eastern Africa, the data indicates that we need to rethink this patriarchal model. Research has shown that females are more resilient and play greater roles in community, which suggests we need to consider abilities outside of sexual dimorphism in order to understand people across the globe in the past and the present.

Differential preservation of population history in vervet skull anatomy

NATALIE O'SHEA[1,2,3], RYAN RAAUM[1,2,3], CHRISTOPHER A. SCHMITT[4], HANNES SVARDAL[5] and ERIC DELSON[1,2,3,6,7]

[1]PhD Program in Anthropology, The Graduate Center, City University of New York, [2]The New York Consortium in Evolutionary Primatology, (NYCEP), [3]Department of Anthropology, Lehman College, City University of New York, [4]Department of Anthropology, Boston University, [5]Gregor Mendel Institute, Austrian Academy of Science, Vienna Biocenter (VBC), [6]Department of Vertebrate Paleontology, American Museum of Natural History, [7]Institut Català de Paleontologia Miquel Crusafont (ICP), Universitat Autònoma de Barcelona

Studies of extant modern human variation suggest cranial morphology is a reliable proxy of past population history. However, it is unclear to what extent cranial variation reflects relationships among populations which have been evolving separately for longer periods of time. The relationship between genes and morphology in taxa which are morphologically distinguishable but not yet reproductively isolated (i.e., allotaxa) is of interest to paleoanthropologists because this intermediate level of divergence is likely similar to what is found in the human fossil record. This study tests the correlation of genetic and morphological distances among nine populations of vervets (genus *Chlorocebus*), a taxon with five to six recognized morphotypes. Three-dimensional landmark data from 303 individuals with known sex and locality information was broken down into a series of landmark configurations representing eleven functional and developmental modules. Morphological distance (P_{ST}) matrices were constructed for each module from the principal components which accounted for 95% of overall variance. A genetic distance (F_{ST}) matrix was derived from single nucleotide polymorphism (SNP) data from 124 individuals sampled across Africa. Mantel tests were performed to assess the correlation between genetic and morphological distance matrices. Results suggest that (1) multiple regions of the skull are strongly correlated with genetic distances, (2) morphological distances are more strongly correlated with genetic distances among populations than among morphotypes, and (3) male morphology is more strongly correlated with genetic distances than female morphology. Future analyses will incorporate environmental data to assess the relative contribution of ecological distance to genetic and morphological differentiation.

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Perinatal health as an indicator of Maternal health factors during the Roman Civil War: preliminary analysis of the Put Dragulina Cemetery, Trogir, Croatia

ANNA J. OSTERHOLTZ

Anthropology and Middle Eastern Cultures, Mississippi State University

Preterm and perinatal health is used here to reconstruct maternal health factors during the great Roman civil war through analysis of remains from the Put Dragulina cemetery in modern-day Trogir, Croatia. The adult population was subjected to social and nutritional stresses during this conflict, when the citizens of Tragurium maintained support for Pompey despite their neighbor's support of Caesar in the civil war. Perinates and preterm individuals receive all nutrition from maternal sources, so dietary insufficiencies manifested in the remains of the young will be a reflection of dietary insufficiencies in the mother.

Every perinatal and preterm individual for which pathology could be scored exhibits signs of systemic, long-term nutritional stress manifested through porotic hyperostosis, cribra orbitalia, and periosteal deposition on the long bones. Though differential diagnosis is difficult due to marginal preservation in some individuals, the ubiquitous nature of periosteal deposition on the bones suggests systemic deficiencies existing in the mother who is unable to provide nutrition either trans-placentally or through breast milk. Included in this discussion are common deficiencies such as rickets and scurvy, both of which have been identified in other perinatal and preterm individuals from other European contexts.

This poster will detail the analysis of 41 burials, 17 of which were under one year of age at death. It will provide social context for the analysis of these remains and detail the pathological changes within the perinates and preterm individuals and their relationship to maternal health.

Capturing 3-D locomotor kinematics in wild mountain gorillas (*Gorilla beringei beringei*)

KELLY R. OSTROFSKY[1], NATHAN E. THOMPSON[2], SHANNON C. MCFARLIN[1], MARTHA M. ROBBINS[3], TARA S. STOINSKI[4] and SERGIO ALMÉCIJA[1,5]

[1]Center for the Advanced Study of Human Paleobiology, The George Washington University, [2]Department of Anatomy, New York Institute of Technology College of Osteopathic Medicine, [3]Department of Primatology, Max Planck Institute for Evolutionary Anthropology, [4]., Dian Fossey Gorilla Fund International, [5]Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona

While functional interpretations for skeletal morphology of living and fossil taxa are often made based on comparative locomotor data for extant taxa, detailed locomotor data for many primates are quite limited. Particularly, 3-D kinematic data on living apes are rare, and nonexistent for wild populations. Thus, how apes move around their natural environments remains poorly characterized from a quantitative perspective. Recent advances in technology have generated new methods for practical field-based kinematic data collection.

Here we describe preliminary results from the novel implementation of non-invasive stereophotogrammetric 3-D kinematic methods in the field, focusing on wild mountain gorillas from Bwindi Impenetrable National Park, Uganda and Volcanoes National Park, Rwanda. Multiple Go-Pro cameras were used to record synchronized video of mountain gorilla locomotion, including both terrestrial and arboreal behaviors. Using 'videogrammetry', 3-D point clouds representing each video frame were generated, and virtual markers were collected to calculate 3-D joint angles. Here we present 3-D joint angles during vertical climbing in mountain gorillas, and compare this to published data on captive lowland gorillas.

During climbing of a large-diameter tree, the range of motion (ROM) at the knee joint (~40°) is reduced compared to that of climbing small-diameter substrates; the ROM at the elbow is also relatively small (~15°), and generally remains extended throughout the stride. We compare the results of the new videogrammetry method with more traditional wand-calibration methods. Overall, these results indicate that it is possible to quantify the kinematics of wild primates to better understand the form-function relationship in living species.

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The Role of Simulated Data in Making the Best Predictions

STEPHEN D. OUSLEY[1], GEORGE R. MILNER[2], JESPER L. BOLDSEN[3] and RICHARD L. JANTZ[4]

[1]Information Sciences, Mercyhurst University, [2]Anthropology, Pennsylvania State University, [3]ADBOU, University of Southern Denmark, [4]Anthropology, University of Tennessee

Machine Learning (ML) methods for regression and classification, along with the bootstrap, have revolutionized the analysis of data through resampling. The resulting simulated data sets are used to select the best fitting models and to estimate prediction precision and accuracy. These two tasks are especially important in forensic analyses, which should reflect predictive data analysis because they will be applied to new cases, rather than summarized in descriptive data analysis. Naturally, we want to use the methods that are expected to be the most accurate and precise for new cases. However, as the great Zen master Berra noted, "It's tough to make predictions, especially about the future." Predictive methods must therefore incorporate the "Known Unknowns" (Rumsfeld, 2002), and avoid overfitting by analyzing multiple independent training and test samples, each of which ideally should be large. Bootstrap and Monte Carlo methods mimic sampling variability that would be present in future cases, and both methods are incorporated into numerous routines to estimate prediction accuracy. No routine is perfect due to bias and variance issues, and to the nature of the data and the analytical method. New routines are always being explored.

This presentation provides results from two forensic scenarios: predicting sex and ancestry using bone measurements, and predicting age using many osteological traits with a new method (*TA3*). We demonstrate that the consequences of supposed overfitting may be relatively small in classification, and predicting age using *TA3* is far more accurate than using previous methods, even with their underestimated prediction error.

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Demographic analysis of ancient individuals from British Columbia using mtDNA and Y-chromosome data

AMANDA C. OWINGS[1], HONGJIE LI[2], SHIZHU GAO[2], BARBARA PETZELT[5], JOYCELYNN MITCHELL[5], JEROME S. CYBULSKI[4] and RIPAN S. MALHI[1,2,3]

[1]Program in Ecology, Evolution, and Conservation Biology, University of Illinois at Urbana-Champaign, [2]Department of Anthropology, University of Illinois at Urbana-Champaign, [3]Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, [4]Research Division, Canadian Museum of History, [5]Metlakatla Treaty Office, Prince Rupert, British Columbia

The population history of indigenous individuals is more fully understood by including research on the effects of European colonization. Such research can include matrilineal and patrilineal histories using mitochondrial DNA (mtDNA) sequences and Y-chromosome SNPs and STRs. Archaeological sites in Prince Rupert Harbour (PRH) on the north coast of British Columbia, Canada have unearthed over 250 individuals. Their descendants live in three nearby Tsimshian communities. We present mitogenome data from 20 ancient and 20 living individuals, along with Y-STR and Y-SNP data from 50 ancient and 48 living individuals. Haplogroup analysis of ancient individuals indicates 80% haplogroup A, 17% haplogroup C, and 3% haplogroup D for mtDNA, and 71% haplogroup Q and 29% haplogroup C for the Y-chromosome. Network diagrams demonstrate shared ancient and living mtDNA haplotypes, but no shared Y-STR haplotypes between these populations. A previous autosomal study found a 57% reduction in effective population size in the descendant population. Genetic diversity analyses of both mtDNA and Y-STRs have been conducted and show no reduction in Y-chromosome DNA diversity and 50% reduction in mtDNA diversity from the ancient PRH population to the present-day population. These results indicate the impact of European colonization on the mitochondrial genomes and Y-chromosomes of a First Nation population in British Columbia.

The physiological linkage between dental arch asymmetry, alveolar inclination and dental macrowear pattern

GREGORIO OXILIA[1,2], EUGENIO BORTOLINI[2], SERGIO MARTINI[3], ANDREA PAPINI[4], MARCO BOGGIONI[5], LAURA BUTI[2], GRANT TOWNSEND[6], JOHN KAIDONIS[6], LUCA FIORENZA[7,8], EMANUELA

CRISTIANI[9], OTTMAR KULLMER[10,11], JACOPO MOGGI-CECCHI[1] and STEFANO BENAZZI[12,2]

[1]Department of Biology, University of Florence, [2]Department of Cultural Heritage, University of Bologna, [3]Dental Lab Tecnician, Dental Lab - via Milani, 1, 37124, Parona (Verona), Italy, [4]Dentist's surgery, via Walter Tobagi 35, 59100, Prato, Italy., [5]Dentist's surgey, via D'Andrade 34/207, 16154, Genova Sestri Ponente, Italy., [6]Adelaide Dental School, The University of Adelaide, [7]Department of Anatomy and Developmental Biology, Monash University, [8]Department of Earth Sciences, University of New England, [9]Department of Oral and Maxillo Facial Sciences, Sapienza University, [10]Department of Palaeoanthropology, Senckenberg Research Institute, [11]Department of Paleobiology and Environment, Institute of Ecology, Evolution, and Diversity, Johann Wolfgang Goethe University, [12]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology

Exact symmetry and perfect balance between opposite jaw halves as well as between antagonistic teeth is not frequently observed in natural masticatory systems. Research results show that asymmetry in our body, skull, and jaws is mainly related to non-genetic environmental and individual ontogenetic factors. However, modern humans exhibit increased variability in tooth positions and asymmetry compared to non-human primates and most fossil hominins. The present work investigates the relationship between the dental macrowear pattern (Occlusal Fingerprint) and alveolar rim inclinations on a 3D-digitized sample of complete maxillary and mandibular dental arches from 19 young and adult Yuendumu Aboriginal individuals. A virtual Occlusal Fingerprint Analysis (OFA) was carried out on first molars (M1) from all four quadrants. Virtual models were oriented identifying a standard plane for each jaw. OFA was used to obtain M1 macrowear patterns, in parallel 2D cross-sectional geometric analysis of the jaws was carried out to assess asymmetry in dental arches and occlusal relationship. Asymmetry observed in the present sample is highly variable on both arches, and it is associated with differences in the inclination of upper M1 crowns. Wear facet position on opposite teeth also reflects differences in inclination of the molars between left and right sides. Our results suggest that overall asymmetry in the masticatory apparatus of modern humans affects the contact situation between opposing teeth severely conditioning the macrowear patterns, probably leading to a high variability in modern human populations.

Oral microbiome variation in chimpanzees from Gombe National Park

ANDREW T. OZGA[1], REBECCA NOCKERTS[2], MICHAEL L. WILSON[2,3], IAN C. GILBY[4,5], ANNE PUSEY[6] and ANNE C. STONE[1,4,5]

[1]Center for Evolution and Medicine, Arizona State University, [2]Department of Anthropology, University of Minnesota, [3]Department of Ecology, Evolution and Behavior, University of Minnesota, [4]School of Human Evolution and Social Change, Arizona State University, [5]Institute of Human Origins, Arizona State University, [6]Evolutionary Anthropology Department, Duke University

To understand the ancestral microorganisms within the human oral cavity, it is imperative to examine the oral ecosystem of closely related primate species. Dental calculus (calcified plaque) allows for the investigation of long-term microbial genetic information, but has yet to be fully explored within non-human primates. We present results from shotgun prepared, Illumina sequenced dental calculus DNA libraries in order to understand the microbial diversity of wild chimpanzees compared to humans. We compare dental calculus from 16 deceased chimpanzees belonging to the Kasekela community spanning 50 years of occupation at Gombe National Park. These samples are dominated by the microbial phyla Spirochaetes, TM7, and Euryarchaeota, and significantly differ from phyla commonly found within human plaque. We also investigate the presence of 'Red Complex' bacteria within chimpanzees, a group of microbes thought to be associated with periodontal disease in human populations. We discuss how these results fit into our current knowledge of primate oral ecosystems and the implications of these findings for human health and evolution.

Testing for the presence of major urinary proteins (MUPs) in lemurs using SDS-PAGE

LISA M. PACIULLI and LEE A. BYRUM

Biological Sciences, North Carolina State University

Pheromones are chemical signals secreted or excreted by individuals that relay information to others through scent. In rodents, some pheromones are excreted in urine as major urinary proteins (MUPs). MUPs belong to the lipocalin protein family and are thought to be important in pheromone transport by either binding volatile compounds or acting alone as pheromones. Previously, the brown-mantled tamarin (*Saguinus fuscicollis*) was found to excrete two different proteins in urine and scent marks. Recently, the mouse lemur (*Microcebus spp.*) was found to express the WFDC12 protein in urine. Notwithstanding, the extent to which other lemur species express MUPs is not well known. Therefore, the presence of urinary proteins in lemurs was explored. Frozen urine samples were obtained from various lemur species housed at the Duke Lemur Center in Durham, NC. For protein detection, urine samples underwent SDS-PAGE followed by coomassie blue staining. Preliminary results indicate that previously uncharacterized urinary proteins may be found in at least one species, the collared brown lemur (*Eulemur collaris*). The presence or absence of major proteins in lemurs could provide insight into physiological differences between primates and non-primates, as well as the origins and divergence of primates. The shift in primates to a stronger reliance on vision than olfaction could be one of the main traits that caused their divergence from closely related orders. Future research should include obtaining freshly expelled urine samples to confirm the presence of urinary proteins, and identifying the structure and function of any proteins found.

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Gender disparity in nasal fractures during the Yayoi period of Japan

BRIAN D. PADGETT[1] and NORIKO SEGUCHI[2]

[1]Department of Anthropology, The Ohio State University, [2]Department of Environmental Changes, Faculty of Social and Cultural Studies, Kyushu University

Research on the role of women in past societies has been addressed with growing frequency recently, rectifying an oversight in the history of anthropology. Such research has included violence directed at women, as certain patterns of osseous trauma can indicate lethal versus non-lethal intent, and thus suggest whether or not the assailant was a member of the same community. A recent re-examination of human skeletal remains in Japan dated to the prehistoric Yayoi Period revealed a discrepancy in the number of nasal fractures between adult males and females. Among the observed remains, female skeletons exhibited a higher number of nasal fractures compared to male skeletons. Patterns of fracture suggest blunt force trauma. Observed trauma among postcranial remains varied. Nasal fractures are most often caused by direct impact, and are considered reliable evidence for patterns of non-lethal violent intragroup conflict resolution. The studied assemblages represent a comprehensive sample of archaeological sites from northern Kyushu and western Honshu. The subject of this study has long been overlooked in the records of Japanese archaeology. The conclusions contribute to the reconstruction of the reality of the people of the Yayoi period, and helps to clarify the role of women in the development of early Japan.

Social behavior and genetic relatedness in highland woolly monkeys (*Lagothrix lagothricha lugens*) at Cueva de los Guácharos National Park, Colombia

ELSY JOHANNA PAEZ-CRESPO[1], PABLO R. STEVENSON[2], ANDRÉS LINK OSPINA[2,3] and ANTHONY DI FIORE[1]

[1]Anthropology, University of Texas at Austin, [2]Biological Sciences, Universidad de los Andes, [3]School of Management, Universidad de los Andes

In primates, members of the philopatric sex are expected to have stronger social bonds with one another than members of the dispersing sex. Among atelins, males are usually described as philopatric, while females tend to transfer from their natal group to other groups. However, molecular and observational evidence suggests that in some woolly monkeys, both males and females may disperse to some degree. We examined patterns same-sex genetic relatedness in a population of highland woolly monkeys (*Lagothrix lagothricha lugens*) in Colombia and compared these to patterns of affiliative behavior. We collected approximately 390 fecal samples noninvasively from all members of two social groups and, for one of these groups, we recorded 222 hours of observational data using focal sampling to document patterns of affiliative behavior. We estimated pairwise genetic relatedness among all adult dyads using 11 highly variable microsatellite markers ($\bar{x}$=7.7±2.3 alleles/locus). In both groups, males were significantly more closely related to one another, on average, than females (Group 1: *r*male=0.17 versus *r*female=0.03, p<0.01; Group 2: *r*male=0.12 versus *r*female=-0.09, p<0.001). These results support the idea that males are the more philopatric sex among highland woolly monkeys, as in other atelins. In the group for which behavioral data were available, we found no correlation between estimated pairwise relatedness and affiliative social behavior for either sex, and intersex affiliation was more common than affiliation within either sex. These results suggest that among adults, affiliative social relationships may not be strongly influenced by dispersal or kinship patterns.

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Male Immigration and Stress in Wild Woolly Monkeys (*Lagothrix poeppigii*)

EVELYN L. PAIN[1], ANTHONY DI FIORE[2], ANDREAS KOENIG[1,3] and AMY LU[1,3]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [2]Department of Anthropology, University of Texas at Austin, [3]Department of Anthropology, Stony Brook University

Dispersal represents a key episode(s) in the life history of individuals, which can be accompanied by stressful ecological and social challenges, such as unfamiliar environments, increased predation risk, loss of kin-support, and aggression upon immigrating. However, these costs are rarely assessed because dispersal events are infrequent and the associated challenges difficult to quantify. Here, we present data on male fecal glucocorticoid (fGC) concentrations in the context of male immigration in wild woolly monkeys (*Lagothrix poeppigii*), a species where both sexes may disperse but dispersal is female-biased. Data were collected at the Tiputini Biodiversity Station in Yasuní, Ecuador from December 2015 to April 2016, and November 2016 to March 2017. We documented 4 cases of attempted immigration by adult males into one of our study groups. We measured fGCs for males throughout the study (average number of samples per male = 9, range 1-17). We examined whether group stability (changing versus unchanging male membership) and immigration status (resident vaacersus immigrant male) affected fGC levels using an LMM (with individual identity and month/year included as random effects). Immigration status did not significantly affect fGC levels, however group stability did (P<0.05), with males in unstable groups having higher fGC levels. These results suggest that instability caused by immigration attempts is stressful for all the individuals involved, but not more so for immigrating males. This may be in part due to the low levels of male affiliation observed for woolly monkeys, which may reduce the amount of cooperative aggression by resident males against immigrants.

Data collection and analysis were supported by the Leakey Foundation, the Nacey Maggioncalda Foundation, the Tinker Foundation, the National Science Foundation (BCS 1638822), and Stony Brook University.

The effects of season and habitat on the mechanical and nutritional properties of potential hominin plant foods

OLIVER C.C. PAINE[1], ABIGALE KOPPA[2], AMANDA G. HENRY[3], JENNIFER N. LEICHLITER[1], DARYL CODRON[4], JACQUELINE CODRON[5] and MATT SPONHEIMER[1]

[1]Anthropology, University of Colorado Boulder, [2]Ecology and Evolution, State University of New York, Stony Brook, [3]Archaeology, Leiden University, [4]Florisbad Quaternary Research Department, National Museum, South Africa, [5]Angewandte und Analytische Paläontologie, Johannes Gutenberg–Universität Mainz

Our understanding of early hominin diets has been challenged in a number of ways over the past decade. For instance, the dental microwear exhibited by *Paranthropus boisei* presents no evidence of hard-object consumption despite the species' initial portrayal as "Nutcracker Man." Also, stable carbon isotope analysis suggests that C4 plants and/or fauna eating C4 plants became increasingly import hominin dietary resources beginning more than 3 Ma. The notion that early hominins were potentially consuming significant quantities of C4 grasses and/or sedges was particularly unexpected because these plants are generally regarded as being nutritionally and mechanically unsuitable for primate consumers. Given this, there is renewed interest in understanding the nutritional and mechanical properties of potential hominin plant foods (C4 or otherwise) and how these properties are affected by their spatiotemporal distribution across African savanna landscapes. Here, we present data from plant samples collected over four field seasons in the Cradle of Humankind, South Africa, and Amboseli National Park, Kenya. We combine data on plant distribution and abundance with analyses of their nutritional and mechanical properties across habitats and seasons. We find that there are strong differences between various food types (e.g., fruits, leaves, underground storage organs) and that habitat and seasonal effects likely influence their potential consumption by hominins, though not in a uniform manner. These data are a first step towards enriching our understanding of early hominin diet and habitat use as means to begin constructing new hypotheses about early hominin dietary ecology.

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The regional variation of the Indian specific mitochondrial DNA haplogroups U2a, U2b, U2c; and the spread of western Eurasian ancestry

MALLIYA GOUNDER PALANICHAMY

Laboratory for Conservation and Utilization of Bio-resources, Yunnan University

The mitochondrial DNA (mtDNA) haplogroups U2a, U2b and U2c are unique to the Indian subcontinent and account for nearly one tenth of the Indian mtDNA gene pool. Previous studies suggest that these haplogroups came to India in a second wave of migration from the west around 40,000 years ago. Hitherto, there have not been any studies looking at the origin of haplogroups U2a, U2b and U2c, and their spread across the Indian populations. However, here we are able to report on an analysis of 664 mtDNA haplotypes (206 from this study) belonging to the haplogroups U2a, U2b and U2c. We include the results from 51 complete mtDNA sequences (21 from this study). The analysis supports the defining of 14 additional subhaplogroups U2a1b1, U2a1b2, U2a1c, U2a3, U2b1a1b, U2b1a2, U2b1a3, U2b1b, U2b1c, U2b2b, U2c1b, U2c1c, U2c2, and U2c3 that extend the present mtDNA phylogenetic tree. The regional specific distribution patterns and estimated coalescence ages of the different U2 subhaplogroups suggest that the ancestors carrying these groups settled in north and east India around 40-50 thousand years ago (kya) and moved into the southern peninsula around 15 kya. We suggest that the spread of the western ancestry autosomal component in the Indian populations was most likely by members of these Indian U2 haplogroups.

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Dental Topography and Food Processing in Wild-Caught Costa Rican *Alouatta*

JAMES D. PAMPUSH[1], PAUL E. MORSE[2,3,4], STEPHEN G.B. CHESTER[5,6,7], JACKSON P. SPRADLEY[8], BLYTHE A. WILLIAMS[2], KENNETH E. GLANDER[2], MARK F. TEAFORD[9] and RICHARD F. KAY[2]

[1]Department of Exercise Science, High Point University, [2]Department of Evolutionary Anthropology, Duke University, [3]Florida Museum of Natural History, University of Florida, [4]Department of Anthropology, University of Florida, [5]Department of Anthropology and Archaeology, Brooklyn College, [6]Department of Anthropology, Graduate Center, City University of New York, [7]New York Consortium in Evolutionary Primatology, [8]Department of Biology and Marine Biology, University of North Carolina at Wilmington, [9]Department of Basic Sciences, Touro University

One goal of functional-biomechanical studies of the dentition is to establish whether changing tooth surface structure with tooth wear effects masticatory efficiency as measured by swallowed food particle size. In a prior cross-sectional study of differentially worn *Alouatta palliata* molars, generalized crown sharpness increased in the initial stages of tooth wear, remained stable through midlife, and then declined as teeth senesced. The aim of this project was to associate tooth surface structure (sharpness) measured via Dirichlet normal energy (DNE), with masticatory efficiency. We analyzed the molar DNE and stomach particle size in two individuals of *A. palliata* from La Pacifica, Costa Rica, each captured six times over four years. One is a young individual (6-9 years old) with a complete adult dentition; the second is an aged individual (24-27) with heavily worn teeth. Stomach samples were collected and casts were made of the lower tooth rows before release. Stomach contents were sieved and dried to produce percentage by weight of each particle size class. As these animals are free ranging, seasonal or temporal fluctuations in diets were not controlled for. Despite these possible confounding effects, the younger individual showed an increasing percentage of the finest stomach food particle size, while the older individual showed a decline in fine particles. These observations are consistent with prior findings in this same population showing a parabolic association between dental surface sharpness and macrowear as described above. Together this suggests that DNE captures functionally significant information about masticatory performance.

Determinants of feeding behavior and food material properties on the deformations of the macaque mandible

OLGA PANAGIOTOPOULOU[1], JOSE IRIARTE-DIAZ[2], HYAB MEHARI ABRAHA[1], ANDREA B. TAYLOR[3], SIMON WILSHIN[4], PAUL C. DECHOW[5] and CALLUM F. ROSS[6]

[1]Anatomy and Developmental Biology, Monash University, [2]Oral Biology, University of Illinois Chicago, [3]Basic Science, Touro University, [4]Biomedical Sciences, The Royal Veterinary College, [5]Biomedical Sciences, Texas A&M University College of Dentistry, [6]Organismal Biology and Anatomy, University of Chicago

Developmental studies reveal links between mandibular corpus morphology and diet, but comparative research in primates does not support strong links between food mechanical properties (FMPs) and corpus morphology. We investigated the effects of variable stiffness (*E*, range=0.5-34MPa) and toughness (*R*, range=105-965Jm^{-2}) in FMPs on mandibular strain patterns and magnitudes using *in vivo* experiments and finite element models (FEMs). We hypothesised that variation in strain magnitudes and orientations when chewing items with different FMPs is minimal at the corpus and greater at the lingual symphysis. FEM results confirmed that across all food items mean maximum principal strain (ε_1) in the chewing side corpus had a range of 86 – 128 με for nuts, 68 – 88 με for soft food, and 38 – 62 με for dry fruit: comparable results were obtained from the in vivo experiment. Nevertheless, the peak ε_1 in the symphysis in FEMs were 1199 με for nuts; 738 με for soft food and 544 με for dry fruit, higher than the corpus. Results also confirmed that strain at the lingual symphysis is relatively insensitive to variation in bite location, whereas strain magnitudes and orientations in the chewing side corpus varied more with bite point. These data suggest that if variation in primate mandibular morphology is driven by variation in strain patterns and magnitudes, then it is likely to be related to a combination of both feeding behaviour and FMPs, but with different factors being important at different mandibular sites.

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The "auriculate extension": a new indicator of pregnancy and childbirth at the sacrum?

DORIS PANY-KUCERA[1,2], MICHAELA SPANNAGL-STEINER[1,2] and KATHARINA REBAY-SALISBURY[1]

[1]OREA, Austrian Academy of Sciences, [2]Department of Anthropology, Natural History Museum Vienna

In the ERC-funded project VAMOS (Value of mothers to society), we investigate the possibility to correlate the social status of women, deduced from grave goods and effort put into grave construction, with their reproductive status. Ongoing anthropological analyses include the detailed systematic study of pelvic features on large skeletal samples from the Central European late Neolithic to the late Iron Age. We record commonly addressed features at the bones of the pelvic girdle, i.e. shape and stage of preauricular sulcus, lesions at the dorsal pubic surface, lesions and exostoses at the ventral pubic side, and shape and exact location of the extended pubic tubercle, in the attempt to find significant patterns. The detailed study of the ilium and sacrum revealed a feature that, to our knowledge, has so far not been described in anthropological literature: the "auriculate extension", a lobe-like feature at the anterior-superior border of the sacral facies auricularis. It was detected in 24 % of females in which the relevant sacrum part was preserved, but none of the male individuals. Often found bilaterally in women of all ages and varying combinations with commonly recorded pelvic features, this feature could be the bony result of a "sacroiliac subluxation" described in the anatomical literature. This condition may result from the tightening of the sacroiliac joint in the wrong position after pregnancy, in which changes of balance had necessitated a shift. These findings might contribute to the discussion on the analysis of pelvic features that may relate to pregnancy and childbirth.

Archaeological Perspectives on the Population History of Modern Humans in India

SHANTI PAPPU and KUMAR AKHILESH

Archaeology, Sharma Centre for Heritage Education, India

Correlating the rich Middle and Late Palaeolithic archaeological record of South Asia with hominin species (modern humans or other archaic species) has been largely hampered by the paucity of Pleistocene hominin fossils. In addition to this, few sites have been systematically excavated or dated. Genetic evidence has been extensively used to the model the probable timing and nature of dispersals of modern humans in and across South Asia. This generated several debates on their relation with the archaeological record. Here, we evaluate existing models derived from archaeological, palaeoclimatological and genetic data over the late Middle and Late Pleistocene in India. We focus on excavations at the site of Attirampakkam (ATM), SE India, that has a sequence of stratified Acheulian and Middle Palaeolithic (MP) assemblages. The MP phases overlie stratified Acheulian horizons dated to between around 1.07-1.7 Ma, and contain a sequence of assemblages with evidence of Levallois flake and point technologies and evolution of blade reduction strategies, with continuity of sparse bifaces in early phases. We contrast this with other MP and Late Palaeolithic sites in this region (8000 km^2), and on the *Teri* microlithic industries closely related to those of Sri Lanka. Results suggest long term occupation in this region over the Late Middle to Late Pleistocene, with variability in landscape use over time, and local evolutionary trajectories in Levallois and blade reduction. We discuss problems in the

correlation of tool types with hominin species in the Indian context.

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Environmental comparisons of the Omo-Turkana Basin and Awash Valley in the Plio-Pleistocene as assessed from enamel stable carbon isotopes

JESSECA PAQUETTE and MICHELLE S.M. DRAPEAU

Department of Anthropology, Université de Montréal

Documenting the environmental context in which hominins lived is a crucial step to a comprehensive understanding of our evolutionary history. The Omo-Turkana Basin and the Awash Valley of East Africa, rich in hominins, are two regions that have been particularly important for documenting environmental changes. Although these two basins have hominin species in common, they also each have taxa that are not found elsewhere. In this context, it is interesting to compare these two basins to determine if they were different and if environmental fluctuations occurred at different periods and/or rates. With this goal in mind, we compared mammalian enamel stable carbon isotopes from the Awash Valley and the Omo-Turkana Basin from 7 Ma to 10 Ka. This method allows us to estimate the proportion of woody plants (closed environments) and tropical grasses (open environments) consumed by the fauna as a proxy of environmental conditions. Our sample consists of a compilation of more than two thousand published mammalian stable isotopic values of East Africa. We calibrated our values to account for relative faunal proportions and general diet differences. Our results indicate similar environments at both basins, suggesting that differences in hominin taxa occurrences are not due to major environmental differences. However, the Omo-Turkana Basin appears to have an earlier shift towards more open habitats at the end of the Pliocene when compared to the Awash Valley, suggesting that the two basins had different sensitivities to global climatic changes.

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The impact of maternal work and received recommendations on infant-feeding practices: A pilot study among Zapotec peoples of Oaxaca, Mexico

NERLI PAREDES RUVALCABA

Anthropology, Michigan State University

Parental investment is any action that will increase the offspring's fitness at a cost of parental fitness. Lactation and weaning are forms of parental investment that are determined by biocultural factors. Within Indigenous communities in Mexico, the increase of Western biomedicine and the introduction of infant formula have influenced traditional infant-feeding practices. This pilot study explored infant-feeding practices among Indigenous Zapotec peoples in Oaxaca, Mexico. Methods: Eight mothers ages 19 to 38 with infants of three years of age or younger were recruited. Semi-structured interviews were conducted on past and current infant-feeding practices, and recommendations mothers had received from biomedical practitioners and family members. Results: All mothers breastfed, and stated breastfeeding was ideal for infant-feeding. However, four mothers introduced formula soon after birth because of work or because of recommendations they received from biomedical staff in private health-care clinics. Mothers were likely to follow recommendations from their mothers regarding the introduction of water, tea, or preparing infant formula with herbal tea. Preparing infant formula with herbal tea is perceived as a way to counter the negative effects of formula on infants' stomachs, as compared to breast milk. All mothers followed biomedical recommendations for introducing solid foods. Conclusion: While not generalizable, this data suggests mothers perceive breastfeeding as ideal; yet, work and biomedical advice may influence the introduction of formula. Additionally, even though biomedical recommendations seem to influence traditional infant-feeding, mothers may still follow recommendations from their mothers if such practices are perceived as having a positive effect on infants' health.

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Accuracy of Self-Reported Height and Weight in US Army Anthropometric Survey

JOSEPH L. PARHAM[1], MEGAN GARLIE[2] and HYEG JOO CHOI[1]

[1]Anthropology Team, Natick Soldier Research Development & Engineering Center, [2]Department of Anthropology, University of Manitoba

Self-reported height and weight are widely used to characterize population level health trends despite the likelihood of inherent biases in such data. Direct measurements are more logistically difficult to obtain, but provide a more accurate assessment of a population's overall size, shape, and condition.

The 2012 US Army Anthropometric Survey (ANSUR II) collected both self-reported and measured height and weight from 1,986 Female and 4,082 Male Soldiers. Comparisons of self-reported to measured data for each Soldier participant reveal systematic biases wherein subjects of both sex overestimated height and underestimated weight. For example, 47% of Female Soldiers overestimated their own stature by more than 13mm (0.5in), while 58.6% underestimated their own weight by more than 2kg (4.4lbs); 68.1% of Male Soldiers overestimated their own stature by more than 13mm (0.5in), while 47.1% underestimated their own weight by more than 2kg (4.4lbs). These discrepancies between self-reported and directly measured dimensions are exacerbated when they are used to calculate Body Mass Index (BMI) to assess the overall health of the population using fixed BMI thresholds and categories. In the ANSUR II sample, approximately 14% of Female Soldiers and 14% of Male Soldiers would be incorrectly grouped with a lower BMI category if self-reported values of height and weight are utilized.

These observed biases not only have the potential to mischaracterize populations, but present difficulty when attempting to identify persons in forensic circumstances where self-reported body dimensions are the only resource available.

Spatial patterns in physical activity and mobility behaviour in the Neolithic and Copper Age central Mediterranean

EÓIN W. PARKINSON, SIMON K.F. STODDART and JAY T. STOCK

Department of Archaeology, University of Cambridge

Long bone cross-sectional geometric (CSG) properties act as reliable indicators of habitual behaviour in past populations. This study compares solid CSG properties of the humerus and tibia in contemporary populations from the Maltese Islands, Sardinia, Alpine and central Italy during the Neolithic-Copper Age transition. The IV-III millennia BC was a period of transformation across Europe, traditionally characterised by economic diversification, technological innovation and the strengthening of gender identities. In particular, the central Mediterranean was a mosaic of archaeologically distinct cultures set against a backdrop of extreme environmental diversity. Solid CSG properties were derived from 3D laser surface scans. The application of innovative methods, such as 3D superimposition, shape fitting and digital reconstruction, were also used to acquire metric data from fragmented and commingled human remains. The results from the humerus show regional differences in upper limb loading between males and females in central Mediterranean groups, alongside overall greater variation in upper limb loading among females. The results from the tibia show no statistical difference in lower limb loading between contemporary central Italian and Maltese groups, suggesting decreased levels of terrestrial mobility, in contrast to the Alpine group which displays adaptions to greater levels of terrestrial mobility around rugged terrain. The findings suggest that regional cultural and environmental diversity has an impact on spatial patterns of biological variability, and supports

archaeological evidence for increasing economic diversification and the strengthening of gender identities in the central Mediterranean during the late Neolithic and Copper Age.

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The more things change: Environmental crisis, health, and 'good choices' in the past

EMILY K. PARNELL[1] and GWEN ROBBINS SCHUG[2]

[1]Institute of Archaeology, University College London, [2]Department of Anthropology, Appalachian State University

Health is often framed as a result of individual choices, decontextualized from historical or socio-structural realities. This paper takes a bioarchaeological approach to the socionatural and biocultural forces that shaped health outcomes at the end of the third millennium BC in South Asia by approaching the legacies of inequality, climate and social changes through dental anthropology. We hypothesized that different socio-structural realities will be associated with different dental pathophysiological profiles at Harappa. Urban period burials, largely comprised of immigrants, will demonstrate higher prevalence of early-life markers of physiological disruption; whereas, individuals buried in the post-urban period, who lived and died as civilization declined, would demonstrate greater risk of violence and dental disease. Results of our analysis of three mortuary populations at Harappa (N=56 individuals, 732 teeth) provides support for this hypothesis. The urban population (cemetery R-37) had the highest prevalence of EH; individuals in the post-urban burials at Area G had greater risk for occupational trauma, dental pathologies, and infectious diseases occurring nearer to the time of death. Variation between burial areas in the expression of acute childhood stress events provides one explanation for the choice to immigrate to urban centers in the urban period. Late Harappan profiles demonstrate the realities of marginalization, through the effects of inequality on health in a time of crisis (2000-1700 BC). Bioarchaeology serves to help deconstruct the narrative of choices in the face of environmental and health crises and to imagine the practical, logistical, and emotional concerns that shaped "choices" in the past.

Revisiting the site: Improved techniques of digitally documenting archaeological and forensic excavations

TED PARSONS and RYAN P. HARROD

Department of Anthropology, University of Alaska Anchorage

As a destructive process, the removal of materials and human skeletal remains from archaeological and forensic sites requires new techniques to record the excavation. In a previous, presentation we discussed the advantages of 3D modeling over traditional methods that include 2D photo documentation, illustration, tape and compass measurement, and total station survey. While these are essential techniques, they are limited because they are two dimensional, or at best collect one 3D point at a time. We present several refinements to our previous work. First, we tested newly-developed field hardware, including a Lenovo cellular phone incorporating Google's Tango 3D capture technology, and a kit-built Scanse Sweep 3D scanner. Tango is very analogous to the Microsoft Kinect V1 we previously used, and the Sweep works like a miniature terrestrial laser scanner. These new sensors require no cables, laptop computers, or external battery packs, a major boost to field mobility. In addition, we refined prior work with the Microsoft Kinect V2 by adopting Brekel commercial capture software. None of these systems costs more than $1000. Our research also assessed improving the quality of 3D models using computer graphics post-processing techniques recently adopted by photo modelers. We extended these refinements to non-photo-based models. All testing used high-precision photo modeling as a baseline. Our test subjects, excavations of black bear (*Ursus americanus)* and plastic anatomical models, closely resemble archaeological and forensic human remains. Our laboratory test site is located off-campus in a heavily wooded area, effectively simulating remote field site conditions.

Excess mortality of respiratory infection during the 1918 influenza pandemic in Newfoundland and Labrador

TAYLOR PASKOFF and LISA SATTENSPIEL

Anthropology, University of Missouri

The 1918 influenza pandemic is widely considered one of the deadliest pandemics in history with a global case fatality rate of approximately 2.5 deaths per 1000 cases. In comparison to a global baseline case-fatality rate in non-pandemic years of 0.5-1.0 deaths per 1000 cases, the 1918 pandemic is firmly in the territory of unprecedented excess. The pandemic reached Newfoundland and Labrador in the spring of 1918, and by the time it had run its course in early 1920, over 2,000 of the Dominion's 250,000 residents had died. Influenza, however, was not the only respiratory disease to exhibit excess patterns. We observe excess mortality of four respiratory infections (influenza, pneumonia, tuberculosis, and bronchitis) for the Dominion as a whole and for its 18 districts from the years 1918-1925 using a 1913-1917 baseline mortality rate. Influenza excess was highest (27.1 excess deaths per 10,000 in 1918), followed by pneumonia and tuberculosis (15.1 and 3.7 excess deaths per 10,000, respectively; bronchitis exhibited no measurable excess). Age and sex distributions of mortality are used to assess the subpopulations of the Dominion that experienced the most excess. Analysis of the age- and sex-based excess mortality for the four respiratory diseases helps explain which demographics were most affected by the 1918 pandemic, and increases our understanding of the potential co-morbidity effects of a variety of respiratory illnesses.

Trends in recent academic job postings for biological anthropology

NICHOLAS V. PASSALACQUA

Anthropology and Sociology, Western Carolina University

The rate of PhD bio-anthropologists that choose academia versus laboratory, or private sector jobs is currently unknown, however it is safe to assume that few professional bio-anthropologists manage to avoid the academic job search. Because of a lack of scholarly information on this topic, this project examined recent trends in academic bio-anthropology job postings. The aim of examining and presenting these data are to: 1) assess recent trends in academic bio-anthropology job postings; and 2) provide information to current and future professionals so that they can better prepare for academic careers in bio-anthropology.

Data for this project came from the Biological Anthropology Academic Job Wiki webpages (see: http://academicjobs.wikia.com). Archived bio-anthropology academic job wiki webpages were available for each academic year from 2010-2011, to 2016-2017. All jobs posted to the bio-anthropology academic job wiki webpages were examined in terms of preferred specialties, job type (e.g., visiting assistant professor, tenure track, etc.), job rank (e.g., assistant professor, etc.) and college/university classification (using the Carnegie Classifications). A total of 474 job postings from 271 institutions were examined from this seven year period. Approximately 52% of these postings were for tenure track positions at the rank of assistant professor, and ~25% were for limited term faculty (e.g., adjunct/visiting); the majority, ~58% were at doctoral institutions. Based on these postings, the most preferred bio-anthropology specialties were evolutionary anthropology and human biology (to include specialties in: health, nutrition, and demography) with these specialties averaging nearly double the postings of the other bio-anthropology specialties.

Cranial morphometric analysis on *Pygathrix nemaeus* and *Pygathrix cinerea*

CARLY PATE, LARRY ULIBARRI, FRANCES WHITE and STEPHEN FROST

Anthropology, University of Oregon

This study analyzes cranial morphometric distinction between *Pygathrix* species. Endangered *Pygathrix nemaeus* and Critically Endangered *Pygathrix cinerea* are endemic to Southeast Asia. They are threatened with extinction due to hunting and habitat fragmentation. While generally understudied, osteological analysis on these species are also uncommon due to lack of specimen collections or accessibility. Although their ranges partially overlap, it is possible to distinguish species based on genotypic and phenotypic pelage differences. However, distinctions of skeletal morphology have not been quantified. *Pygathrix* phylogeny has been debated, with a recent cranial morphometric analysis showing no distinction between species detected through linear measures.

Using 3D photogrammetric methods and linear measures, cranial data was collected on an osteological collection of confiscated and captive red-shanked doucs, *P. nemaeus,* (n=43) and grey-shanked doucs, *P. cinerea*, (n=23), from the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam.

Five linear cranial measures indicate no sexual dimorphism between *P. cinerea* males and females, (n=24, n=19) or between *P. nemaeus* males and females, (n=17, n=6). One linear measure, anterior foramen magnum to the superior most point on sagittal suture, allowed distinction between species among males, (F 4.37, $P<0.05$) and among females, (F 10.06, $P<0.05$). These results indicate a cranial morphometric variation among species. Further 3D shape analysis will continue to explore this distinguishability. Intra- and interspecies variation analyzed morphometrically by 3D photogrammetry can aid in understanding the impacts of species-specific factors such as social structure and feeding ecology on cranial morphological variation.

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Telemetered electromyography of flexor digitorum profundus and flexor digitorum superficialis in chimpanzees revisited 40 years later: implications for interpreting fossil hominin hand morphology

BIREN A. PATEL[1,2], SUSAN G. LARSON[3] and JACK T. STERN, JR.[3]

[1]Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [2]Human and Evolutionary Biology Section, Department of Biological Sciences, University of Southern California, [3]Department of Anatomical Sciences, Stony Brook University School of Medicine

Functional interpretations of marked curvature of proximal phalanges and prominent muscle insertion scars found on proximal and intermediate phalanges in hand fossils of *Ardipithecus*, *Australopithecus*, and early *Homo* are still debated. Since these features are visible in extant great apes and electromyographic data in chimpanzees show relatively high levels of flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) activity during suspension, some researchers have interpreted these features as morphological evidence for habitual suspensory behaviors in early hominins. Others have argued that suspensory behavior is implausible for hominins, concluding that these phalangeal features are more likely associated with climbing, or are just 'phylogenetic baggage'. We used electromyography to broaden our understanding of FDS and FDP recruitment in two chimpanzees. Median, average and peak activity levels in both muscles were quantified during support and swing phases of knuckle-walking (KW), inverted below-branch quadrupedalism (BBQ), below-branch forelimb suspension (SUS), and vertical climbing (VC). During arboreal behaviors, average and median activity levels of FDS are greater than FDP. As shown previously, FDS and FDP are relatively silent during KW. In contrast, both muscles show nearly a seven-fold increase in relative activity during BBQ. During support phases of SUS and VC, both muscles are recruited at even higher levels, but relative activity during these two behaviors are not substantially different from each other. From these results, we suggest that elevated recruitment of the digital flexors during both suspension and climbing are equally likely to contribute to the great ape-like phalangeal morphologies seen in early hominins.

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Metric Sex Determination Between Modern Thai and Native American Populations

MEREDITH M. PATTERSON[1] and SEAN D. TALLMAN[1,2]

[1]Department of Anatomy and Neurobiology, Boston University School of Medicine, [2]Department of Anthropology, Boston University

Historically, metric and morphological standards used in forensic anthropology and bioarcheology were derived from individuals of European and African descent and ancient Native Americans. However, it is unlikely that these standards can be accurately applied to modern Asian populations. Due to different population histories, it is hypothesized that ancient Native American and modern Thai individuals are metrically distinct. This study investigates the metric differences in sexual dimorphism between 102 Native American (American Museum of Natural History) and 100 modern Thai (Khon Kaen University) individuals 17 to 97 years of age. A total of 26 cranial and 57 postcranial measurements were tested in Spradley and Jantz's (2011) American Black and White sex determination equations to see how equations derived from non-Asian populations perform on Native American and Thai individuals, and to ascertain if population differences exist in the expression of sexual dimorphism.

Using logistic regression equations and discriminant function analyses – quasi-ordinary least squares, the Native American and Thai groups are significantly different in the expression of sexual dimorphism. Further, Spradley and Jantz's (2011) equations often fail to correctly classify Native American and Thai individuals. Particularly, the equations derived from American Black and White individuals frequently classified modern Thai and Native American males as females. Conversely, three American White equations and eight American Black equations classified more females as males for both populations. Therefore, the metric sex determination methods developed on non-Asian populations do not adequately classify Native American and Thai individuals, which reiterates the importance of the population-specific equations presented here.

Quantitative genetic analyses of human tooth crown morphology: heritability and genetic integration in a longitudinal Australian twin sample

KATHLEEN S. PAUL[1], CHRISTOPHER M. STOJANOWSKI[1], TOBY HUGHES[2], ALAN BROOK[2] and GRANT C. TOWNSEND[2]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Adelaide Dental School, The University of Adelaide

Tooth crowns represent a crucial source of data in the study of evolutionary processes and biological relationships due, in part, to their propensity to withstand most taphonomic processes. In particular, crown morphology has featured prominently in the reconstruction of human migrations, population interactions, as well as site formation processes and biological cemetery structure. These studies operate under the foundational assumption that dental phenotypic variation reflects underlying genotypic variation. Yet, limited validation research has been dedicated to ground-truthing this assumption. For example, few quantitative genetic studies have focused on discontinuous morphological traits; this is especially true for the deciduous dentition. Here, we present a suite of narrow-sense heritability estimates and genetic correlations for deciduous and permanent crown morphology generated from a sample of Australian monozygotic and dizygotic twin pairs and their families (N=339). These estimates were obtained from 207 maximum-likelihood variance components models generated using SOLAR v. 8.1.1. Results

indicate a relatively consistent contribution of additive genetic variance to morphological variance across the human diphyodont dental complex (i.e., across both dentitions and arcades: deciduous maxillary mean *h2*=0.62; deciduous mandibular mean *h2*=0.65; permanent maxillary mean *h2*=0.66; permanent mandibular mean *h2*=0.51). Genetic correlations indicate greater morphological integration for the permanent dentition as compared to the deciduous dentition. Importantly, results indicate incomplete or complete pleiotropy for a greater percentage of the deciduous-permanent homologue sample (67%) as compared to the within-class trait pairs in the deciduous (21%) and permanent (33%) dentitions, which suggests a genetic mechanism for the conservation of crown morphology across succedaneous elements.

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Extremities at the Extremes: Ice-water immersion of the hand as a test of cold adaptation theory

STEPHANIE PAYNE

Department of Archaeology and Anthropology, University of Cambridge

While the evolution of the human hand in relation to tool use has been thoroughly scrutinised, the role of the hand in thermoregulation is often overlooked. Our hands have the highest surface area-to-volume ratio of any body segment and thus can act as an important means of heat loss. Variation in human hand proportions has been attributed to climatic adaptation, whereby shorter, broader digits and hands theoretically minimise heat loss in cold conditions, but the assumptions behind this theory have not been tested *in vivo*. This research is the first to investigate whether hand proportions, body size, and body composition influence heat loss from the hand in real time, and whether dynamic thermoregulatory vasomotor responses minimise any of these potential influences. Thermal imaging was used to determine heat loss during a three-minute ice-water hand immersion test carried out on 114 volunteers (Female=63, Male=51). Body size and body composition were measured and 3D scanning techniques were used to quantify hand size and volume. Analysis demonstrated that skeletal muscle mass relative to body mass, and hand width relative to stature, were the key predictors of heat loss. These results provide empirical support for the theorised relationship between climatic adaptation and hand proportions among human populations, but also demonstrate the importance of body composition in mediating heat loss from the hands.

A hominin humerus from the late Middle Stone Age of Rusinga Island, Lake Victoria, Kenya

OSBJORN M. PEARSON[1], ETHAN C. HILL[1], DANIEL J. PEPPE[2], J. TYLER FAITH[3,4] and CHRISTIAN A. TRYON[5]

[1]Department of Anthropology, University of New Mexico, [2]Department of Geosciences, Baylor University, [3]Department of Anthropology, University of Utah, [4]Anthropology, Natural History Museum of Utah, [5]Department of Anthropology, Peabody Museum of Archaeology and Ethnology, Harvard University

We present a description of a right hominin humerus (KNM-RU 58330) that was surface-collected in a small gulley in 2010 at Nyamita in the Upper Pleistocene Wasiriya Beds on Rusinga Island, Kenya. Before preparation, the specimen was coated with a crust of calcium carbonate like other fauna from the site. The underlying Wakondo tuff and radiocarbon dates on overlying gastropods indicate the humerus is between ~68-36 ka in age. The associated fauna is dominated by semi-arid grassland taxa. A small sample of associated MSA lithic artifacts include Levallois flakes, cores, and retouched points. The humerus preserves 139 mm of its diaphysis from distal to the lesser tubercle to 14 mm below the deltoid tuberosity. The ragged proximal end is attributable to carnivore gnawing while the perpendicular fracture marking the distal end indicates dry-bone breakage. The deltoid tuberosity is fairly broad but only weakly projecting. The pectoralis major insertion is narrow and weakly marked. The diaphysis bends medially near the distal end, an unusual feature that also occurs in a few other Pleistocene human humeri. The distal end approximates midshaft and measures 22.5 by 17.0 mm (maximum and minimum), which predict a length of 312.3 mm based on recent samples of African ancestry. The distal end's cross-sectional geometry has a high percentage of cortical bone (79.0%) and a moderate degree of flattening with an Imax/Imin ratio of 1.80. The specimen adds to the small sample of MSA hominins from East Africa.

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Simulating species representation in the South African fossil record: A critique of the Turnover-Pulse Hypothesis

DANIEL C. PEART and JEFFREY MCKEE

Anthropology, The Ohio State University

Analysis of human evolution is often dependent on an incomplete fossil record that requires more scrutiny to draw conclusions about past environmental circumstances. A common interpretation of species representation in the fossil record of South Africa is that turnover of fossil species indicates extinction and speciation related to changing environment. If environmental change motivates turnover pulses of speciation and extinction, then we expect that inclusion of fossils at Plio-Pleistocene sites are the result of the non-random process of natural selection. To test this hypothesis, a simulation of speciation and extinction was created that produces a fossil record for 3.2 million years. This program was extended to include a sampling subroutine that simulates the species representation at South African fossil sites by randomly extracting the same number of species from the virtual landscape at the time interval for that site. Results indicate that species turnover by random sampling is statistically similar to the turnover apparent in the South African fossil record. This further evidence does not support the Turnover-pulse hypothesis and provides another reason to be skeptical about the association of fossil species turnover and environmental circumstances. Multiple factors influence the preservation and representation of species within the fossil record. Future efforts should be focused on what the species represented means for reconstructing paleoenvironment instead of over-interpretation of fossil species turnover as evidence of environmental change.

Patterns of integration in the hominoid skeleton: a case-study on the wrist

ANGELA PEÑA[1], BIREN A. PATEL[2,3], CALEY M. ORR[4,5] and SERGIO ALMÉCIJA[1,6]

[1]Center for the Advanced Study of Human Paleobiology, George Washington University, [2]Department of Integrative Anatomical Sciences, University of Southern California, [3]Human and Evolutionary Biology Section, Department of Biological Sciences, University of Southern California, [4]Department of Cell and Developmental Biology, University of Colorado School of Medicine, [5]Department of Anthropology, University of Colorado Denver, [6]Institut Català de Paleontologia Miguel Crusafont, Universitat Autònoma de Barcelona

Integration refers to the interconnection of morphological traits that results from biological and functional processes. This principle is especially useful in understanding the coevolution of bones that articulate and function together. The wrist provides a unique opportunity to explore patterns of integration as it contains several bones that work in concert during many functions such as locomotion, toolmaking/use, and food processing/consumption. While most recent quantitative studies of the wrist focus on its individual elements, there is a current lack of knowledge about the patterns of integration among them and how those patterns relate to function and/or phylogeny.

This study focuses on the capitate and hamate of the great ape and human wrist. Twenty-three fixed and 300 sliding semilandmarks and 15 fixed

and 300 sliding semilandmarks were collected on the hamate and capitate, respectively, to capture their shape complexity. Two-block partial least squares analysis (2B-PLS) was used on the Procrustes-superimposed landmark coordinates to quantify the level of integration between bones. The results demonstrate that there is a strong level of integration between the capitate and hamate within hominids (r-PLS=0.926, p<0.001). However, *Pan* and *Gorilla* are more similar to each other than they are to *Pongo*, and all three great apes are more similar to each other than they are to *Homo*, in their patterns of integration. This study prompts future pairwise analyses on additional primate taxa and other wrist elements to evaluate carpal bone integration across primates.

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Adaptable apes: reconstructing habitats through space and time in the early Miocene of East Africa

DANIEL J. PEPPE[1], SUSANNE COTE[2], ALAN DEINO[3], STEVEN G. DRIESE[1], DAVID L. FOX[4], JOHN KINGSTON[5], RAHAB KINYANJUI[6], ROBERT M. KITYO[7], THOMAS LEHMANN[8], WILLIAM E. LUKENS[1], KIRSTEN JENKINS[9], LAURA M. MACLATCHY[5], FREDRICK K. MANTHI[6], EMMA MBUA[10,6], KIERAN P. MCNULTY[9], LAUREN A. MICHEL[11], ELLEN R. MILLER[12], AMON A.T. MUGUME[13], ISAIAH NENGO[14], ALICE NOVELLO[15], KENNEDY O. OGINGA[1] and JAMES B. ROSSIE[16]

[1]Department of Geosciences, Baylor University, [2]Department of Anthropology and Archaeology, University of Calgary, [3]Berkeley Geochronology Center, Berkeley Geochronology Center, [4]Department of Earth Sciences, University of Minnesota, [5]Department of Anthropology, University of Michigan, [6]Earth Sciences Department, National Museums of Kenya, [7]Department of Zoology, Entomology and Fisheries Sciences, Makerere University, [8]Messel Research and Mammalogy Department, Senckenberg Research Institute and Natural History Museum Frankfurt, [9]Department of Anthropology, University of Minnesota, [10]Department of Biological Sciences, Mt. Kenya University, [11]Department of Earth Sciences, Tennessee Tech University, [12]Department of Anthropology, Wake Forest University, [13]Department of Museums and Monuments, Uganda National Museum, [14]Turkana Basin Institute, Stony Brook University, [15]Department of Biology and the Burke Museum of Natural History and Culture, University of Washington, [16]Department of Anthropology, Stony Brook University

Extant apes primarily inhabit forest environments near the equator. In contrast, fossil hominoids occupied a much larger geographic area, but are often argued to have been a forest-adapted group. However, relatively little research has focused on the paleoclimatic or paleoenvironmental preferences of the earliest apes. Here, we present multi-proxy reconstructions of paleoclimate and paleoenvironment from early Miocene sites in Kenya and Uganda spanning a ~5 myr interval from ~21.5 – 16.5 Ma to assess the environmental preferences of the earliest apes. Mean annual temperature estimates indicate a stable megathermal climate. Precipitation estimates indicate that rainfall was seasonal, that most sites experienced intervals with little to no rain throughout the year, and that mean annual precipitation was variable through time. Reconstructions of vegetation indicate considerable differences ranging from relatively open sites with common grass to closed sites with evidence for multi-storied closed-canopy forest. These results demonstrate paleoclimate across East Africa in the early Miocene was variable, primarily driven by changes in precipitation. This variability is also linked to fluctuations between more open and more closed environments. Thus, dense forests were not consistently present on the landscape and the earliest apes occupied a variety of habitats.

These results demonstrate that the original adaptive niche of apes was probably not confined to dense tropical forests and the current reliance on dense forests may be a more recent phenomenon. Instead, early Miocene apes adapted to diverse wooded habitats and climatic and habitat variability likely played an important role as a driver of hominoid evolution.

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Testing the beta version of rASUDAS on extant human populations: promises and pitfalls

ROSE L. PERASH, LAURA E. CIRILLO, STEPHANIE J. COLE, CORTNEY N. HULSE, MICHAELA J. SCHROEDER, CASSIE E. SKIPPER and G. RICHARD SCOTT

Department of Anthropology, University of Nevada, Reno

A web-based application (rASUDAS) was developed to assess ancestry from tooth crown and root morphology. Posterior probabilities for ancestral group assignments are calculated using a naïve Bayes classifier algorithm. For this study, 13 tooth crown traits were observed on dental casts from 1028 individuals in seven modern human populations corresponding to six of the seven biogeographic ancestry clusters in rASUDAS: Bantu (Sub-Saharan African), Yuendumu (Australo-Melanesian), American Whites (Western Eurasian), Asiatic Indians (Western Eurasian), Southwest Indians (American Indian), Chinese (East Asian), and Malay (Southeast Asian). Correct classifications for the first and second highest posterior probabilities combined were 38.7% for Malay (6.6/32.1), 60.6% for Yuendumu (32.5/28.1), 62.6% for Chinese (33.8/28.8), 72.9% for Southwest Indian (39.6/33.3), 80.7% for Bantu (53.0/27.7), 68.2% for Asiatic Indians (50.9/17.3) and 89.1% for American Whites (69.7/19.4). Southeast Asians are the most difficult to classify using rASUDAS because they often exhibit intermediate trait frequencies. For other geographic regions, results demonstrate the potential of rASUDAS for estimating the ancestry of individuals in modern human populations. The beta version of this application is not the final product. Results reflect a bias toward traits in the ASUDAS that are most common in East Asian and derived populations. The addition of nonmetric dental traits more common in Sub-Saharan Africans (e.g., labial convexity, mid-line diastema, mesial canine ridge, crenulations, etc.) will further increase the classificatory accuracy of rASUDAS in forensic and bioarchaeological contexts.

Changes to limb yield and effective limb length in response to support orientation in primates

BERNADETTE A. PERCHALSKI

Evolutionary Anthropology, Duke University

When moving on horizontal surfaces, primates show relatively higher limb compliance compared to non-primate mammals. When moving down sloped terrestrial supports, non-primate mammals further decrease their forelimb compliance. This study tests whether primates alter compliance when walking down steep supports by examining changes to forelimb and hind limb yield and effective limb length (ELL). Species observed included *Daubentonia*, *Eulemur*, *Lemur*, and *Varecia* (n =4 per species), *Nycticebus* (n = 2), and *Propithecus* (n = 3), filmed at the Duke Lemur Center walking on horizontal poles and descending inclined poles (oriented between 15 and 90°) headfirst. Symmetrical gaits were digitized with anatomical landmarks to measure ELL at midstance, as well as elbow, knee, and ankle angle at touchdown, and midstance. Limb yield was measured as changes to joint angle from touchdown to midstance. All species responded similarly to increasing angle of support orientation with increasingly flexed knees and extended elbows at touchdown. At supports angled up to 45°, elbow, ankle and knee yield increased, and fore and hind ELL decreased. Above 45°, knee and ankle yield decreased, while elbow yield continued to increase; fore and hind ELL continued to decrease. These highly flexed postures, especially above 45°, may function to reduce risk of pitch; however, landing with increasingly flexed hind limbs may come at the expense of limb yield. Primates appear to modify their gaits on arboreal declines differently than non-primate mammals walking on sloped terrestrial supports, further supporting hypotheses

relating primate limb compliance to navigation of complex arboreal environments.

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Thermo-Energetic Metabolic Demands and Daytime Behavioral Patterns of a Wild Cathemeral Monkey

JUAN P. PEREA-RODRIGUEZ, MARGARET K. CORLEY and EDUARDO FERNANDEZ-DUQUE

Anthropology, Yale University

Endotherms benefit by being active during the warmer periods of the 24-h cycle and resting when temperatures drop because this results in lower energetic investment in thermoregulation. In accordance with this hypothesis, the cathemeral Azara's owl monkeys of the Argentinean Chaco (*Aotus azarae*) increase daytime activity during the relatively cold austral winter. Still unclear is how changes in ambient temperature may influence, during daytime, the allocation of time to behaviors that tend to conserve energy (resting), to increase its availability (foraging), or to use it (traveling). We constructed an a priori set of linear models to evaluate the separate relationships between photoperiod, moonlight, age class, reproductive status, and hourly and daily measures of ambient temperatures. We predicted that at colder temperatures monkeys would spend more of the daytime foraging and less traveling and resting to compensate for an increase in thermoregulatory needs. We analyzed 5516 20-min focal observations collected between 06:00-21:00 hs from 146 recognizable monkeys during 2001-2015. Our results indicate that, from the warmest to the coldest months, individuals decreased the average frequency of daytime resting by 30%, and, when active, monkeys decreased the average frequencies of daytime traveling behaviors by 40% and increased the average frequency of daytime foraging by 80%. Daytime resting, traveling, and foraging frequencies were best explained by the temperatures at the time when animals were sampled but not by other factors in the models fitted. Our results suggest that the cathemeral behavior of *A. azarae* may be influenced by patterns of ambient temperature.

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Gut microbiome diversity across sympatric wild mammal populations of Madagascar reflects diet, habitat use, and host phylogeny

AMANDA C. PEROFSKY[1], REBECCA J. LEWIS[2] and LAUREN ANCEL MEYERS[1,3]

[1]Integrative Biology, University of Texas at Austin, [2]Anthropology, University of Texas at Austin, [3]., Santa Fe Institute

Host phylogeny and environmental factors are known to contribute to variation in gut microbiota composition across mammal species. However, most mammalian microbiome studies have compared samples collected from disparate wild or captive populations. To evaluate the relative influences of geographic, phylogenetic, and dietary proximity on natural variation in gut microbiome composition, we conducted comparative analyses of gut microbiomes from six co-occurring primate and non-primate mammal species inhabiting a 1-km^2 area in western Madagascar (Verreaux's sifaka, *Propithecus verreauxi*; red-tailed sportive lemurs, *Lepilemur ruficaudatus*; red-fronted brown lemurs, *Eulemur rufifrons*; fossa, *Cryptoprocta ferox*; African bush pigs, *Potamochoerus larvatus*; and cattle, *Bos indicus*). Gut microbiomes clustered distinctly according to host species identity, and microbiota-based random forest models predicted host species origin with 100% accuracy. Gastrointestinal morphology and diet were strong predictors of within-host microbial diversity, whereas terrestriality influenced patterns of similarity in taxonomic composition among host species. Using both phylogenetic and sample ordination approaches, we found that gut microbial community assembly was generally phylosymbiotic, with the ecological relatedness of host-associated microbial communities reflecting the established evolutionary relationships of host species, except for within the clade encompassing the three lemur species. Through examining the predicted functional composition of lemur gut microbiota, we determined that this discordance could be attributed to differential dietary intake (*i.e.*, reliance on plants versus fruit) among lemur host species. Our results demonstrate that, among sympatric wild mammal populations, evolutionary history and habitat use dictate microbial similarity among distantly-related species, whereas diet can be more influential in differentiating closely-related species.

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Human tapeworm functional and evolutionary genomic adaptations to cooking-related heat stress

GEORGE PERRY[1], CHRISTINA BERGEY[1], STEPHEN JOHNSON[1], ABBY KOENIG[1], ALEXIS SULLIVAN[1], BELGEES BOUFANA[2], PHILIP CRAIG[3], YESENIA CASTILLO[4], SIDDHARTHA MAHANTY[5] and HECTOR GARCIA[4]

[1]Departments of Anthropology & Biology, Penn State University, [2]Istituto Superiore di Sanita, National Institute of Health, [3]School of Environment & Life Sciences, University of Salford, [4]Center for Global Health, Universidad Peruano Cayetano Heredia, [5]Peter Doherty Institute for Infection and Immunity, University of Melbourne

Tapeworms have a complex lifecycle that requires both definitive (carnivore) and intermediate (typically herbivore) hosts, with adult parasites developing in carnivore intestines following the consumption of herbivore tissues containing tapeworm cysts. Thus, phylogenetic and evolutionary biology studies of tapeworms can provide valuable proxy insights into our understandings of the history of meat eating and associated cultural behaviors of definitive host species. Three tapeworm species primarily parasitize humans: *Taenia solium* (secondary host: pigs), *T. asiatica* (pigs), and *T. saginata* (cattle). We are using an integrative functional and evolutionary genomics approach to test the hypothesis that these tapeworms may have evolved to withstand heat stresses associated with meat cooking, a uniquely human behavior. First, we heated *T. solium* cysts to temperatures from 37 to 56 degrees C, followed by RNA sequencing to identify significantly differentially expressed genes. We also sequenced and assembled the genomes of 9 Taenia tapeworm species (including the three human taxa) to identify gene families with elevated duplication rates on the human lineages, and to intersect these results with those from the RNA-seq experiment. We identified genes differentially expressed under high temperature whose protein products are known to be involved in the heat stress response (e.g., heat shock 70 protein, q=4.2x10-16; universal stress protein, q=9.9x10-35; cytochrome c oxidase II, q=5.2x10-30). While our comparative genomic analyses are ongoing, we preliminarily observe significantly more heat shock protein gene copies in the genomes of the three human tapeworm species than in those of any other tapeworm.

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Primates at the Northern Edge: Update on Faunas from the Middle Eocene of Saskatchewan

JONATHAN M G. PERRY[1], KRISTEN A. PRUFROCK[1], ALEXANDER DUTCHAK[2] and JESSICA M. THEODOR[3]

[1]Functional Anatomy and Evolution, Johns Hopkins University, [2]Geosciences, University of Calgary, [3]Biological Sciences, University of Calgary

The northern edge of the New World distribution of non-human euprimates is represented by localities of Duchesnean and Uintan age in southwest Saskatchewan. These localities and the primates therein were described by John Storer between 1984 and 1996. The Duchesnean Lac Pelletier local faunas have yielded several isolated teeth belonging to three species of omomyid, and one species of *Uintasorex*, a microsyopid. The Uintan Swift Current Creek (SCC) locality has yielded three teeth of omomyids belonging to

two species, neither of which has been fully described. Since 2014, new collaborative fieldwork and matrix sorting have yielded additional remains of euprimates and plesiadapiforms from SCC. These include a probable m3 of *Uintasorex* and an upper molar of *Trogolemur*. Upper dentitions of *Trogolemur* are rare and consist of isolated teeth. Comparison of these teeth to those of other omomyids suggests that some previous identifications to tooth locus were incorrect. The new tooth is likely an M3 of *Trogolemur leonardi*, representing a temporal range extension for this species. Comparisons of the SCC omomyids to those in other collections from southwestern and northern United States has provided more confident species allocations. Future work on these Canadian faunas will focus on making collections from a new Uintan locality and continued sampling of matrix from SCC (via acid preparation), with better stratigraphic control than previously possible. Later-occurring omomyids with Asian affinities in Oregon and South Dakota (i.e., *Ekgmowechashala*) are consistent with a dispersal route through western Canada; continued fieldwork might reveal additional primate diversity.

Behavioral innovation in wild white-faced capuchin monkeys, *Cebus capucinus*, at Lomas Barbudal, Costa Rica

SUSAN E. PERRY[1], BRENDAN J. BARRETT[2] and IRENE GODOY[3]

[1]Anthropology & Behavior, Evolution and Culture Program, UCLA, [2]Anthropology Department & Animal Behavior Group, University of California-Davis, [3]Behavioural Science Institute, Radboud University Nijmegen

Innovation is important to researchers of cultural processes because it is the primary source of new behavioral traits. Situating species' innovation repertoires in their natural history can inform us about the selective pressures on creative intellect. We explicitly recorded all observations of innovation for ten years, requiring that a behavior not be seen in the same group in the previous 5 years to qualify as innovative in the subsequent 5 years. We used hierarchical zero-inflated Poisson models to estimate individual innovation rates. Of 187 innovation events documented during 35,196 hrs of observation of 234 individuals in ten social groups of wild capuchins, only 127 innovations were unique, i.e. invented in only one group. 17 of these innovations were novel ways of processing food or water; 9 served to enhance comfort, self-soothe, or self-stimulate; 47 were new types of social interaction (e.g. types of aggressive display, bond-testing behaviors, or ways to interact with infants); and 54 were investigative behaviors (i.e. creative ways of manipulating other species or inanimate objects, or novel ways of locomoting). 117 of 234 individuals in the data set innovated at least once. 80% of innovations were not retained in the innovator's behavioral repertoire, and <22% were transmitted to other group members. Older, more socially central monkeys were most prone to invent new social interaction types. Younger monkeys were more prone to invent new foraging, investigative or self-directed behaviors. Sex and dominance rank were not important predictors of innovative tendency.

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An integrative study of the emergence of social inequality: Bioarchaeological and biogeochemical analyses of the *Coyo Oriental* cemetery, northern Chile

WILLIAM J. PESTLE[1], CHRISTINA TORRES-ROUFF[2,4] and MARK HUBBE[3,4]

[1]Department of Anthropology, University of Miami, [2]Anthropology, School of Social Sciences, Humanities and Arts, University of California, Merced, [3]Department of Anthropology, Ohio State University, [4]Instituto de Arqueología y Antropología, Universidad Católica del Norte

The *Coyo Oriental* cemetery of San Pedro de Atacama is one of the largest and most intriguing mortuary contexts of Middle Period (AD 400-1000) northern Chile. The burial treatments found at *Coyo Oriental* attest to foreign influence and a notable association with mining and metallurgical activities, and the skeletons evidence spectacularly elevated rates of cranio-facial trauma and at least one exotic pathology (*Leishmaniasis*). Here, we present the results of Bayesian-modeled isotopic and radiometric analysis of 32% (73/227) of the cemetery's burials.

Radiocarbon dating of each of these seventy-three burials securely demonstrates the Middle Period use life of this cemetery, with a particular concentration of individuals dating to the last four centuries of the period, a time that includes the peak of interregional interaction. In spite of their contemporaneity and a mortuary tradition that placed them in a single cemetery, the *Coyo Oriental* burials show notable isotopic diversity, with 5.5‰ to 6.8‰ variability in all analyzed isotope systems ($\delta^{13}C_{co}$, $\delta^{15}N_{co}$, and $\delta^{13}C_{ap}$), and comparable variation in modeled foodstuff contributions. This variability is presented here in light of a re-analysis of the burials' mortuary treatments and detailed osteological examination of the human remains. We discuss these results in reference to broader questions about the supposed widespread affluence of the Middle Period and the emergence and establishment of social inequality during the Middle Period.

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Nutritional stress, paleopathology and geographic ancestry: an integrative study of enslaved Africans in early New York

KARA PETERS[1], JOSEPH L. JONES[1], MICHAEL L. BLAKEY[1] and ALAN H. GOODMAN[2]

[1]Institute of Historical Biology, Department of Anthropology, College of William and Mary, [2]School of Natural Science, Hampshire College

The skeletal remains from the 18th-century New York African Burial Ground (NYABG) have been analyzed for paleopathology and chemical indicators of geographic ancestry, yet these factors have not been analyzed in relation to one another. In order to further understand the origins and lives of these individuals, the primary goal of this study is to identify nutritional patterns associated with different natal cohorts within the NYABG population.

We compared skeletal health indicators for 49 individuals with prior natality estimations. Based on dental chemistry, these individuals were likely born in Africa (n=13), America (n=26), or the Caribbean (n=4). For these groups, we compared iron (Fe) concentrations derived from whole teeth, i.e., representing a "lifetime average" of dietary exposure, with the presence of nutritional indicators associated with anemia. This condition is partially caused by iron deficiency and results in bone porosity. Specific skeletal indicators included porotic hyperostosis, diploic thickening, cribra orbitalia and bowing of the lower limbs (associated with vitamin D deficiency).

Interestingly, of the 38 (77.5%) individuals with at least one paleopathology, mean iron concentrations varied little across groups. However, concentrations observed among individuals exhibiting porosity are less variable than in those without porosity. Also, individuals born in Africa have significantly higher iron levels than those born in America or the Caribbean, and American-born individuals have significantly more iron than Caribbean-born individuals.Women and individuals of undetermined sex have nearly three times more iron than men. These findings provide new insight into the nutritional health of enslaved individuals in the urban North.

Cultural Variation in Social Object Manipulation between Two Long-Tailed Macaque Populations in Bali, Indonesia

JEFFREY V. PETERSON and AGUSTIN FUENTES

Department of Anthropology, University of Notre Dame

This study investigates the degree to which patterns of object manipulation may be influenced by local primate cultural traditions involved in their exhibition. Cultural variations on object manipulation are present in two allopatric groups of long-tailed macaques (*Macaca fascicularis*) in Bali, Indonesia. At the Padangtegal site macaques engage in stone handling, a form of

object play involving actions like banging and rubbing stones on the ground. At the Uluwatu site macaques steal objects from tourists and then exchange them back for food, a socially learned behavior termed "robbing and bartering". Before the exchange, and in cases with no exchange, these macaques also manipulate their stolen objects manually and by biting them. We have collected 166.75 hours of observation on 28 macaques (14 at each site) to date. Here we present in-depth analyses of 30 bouts of stone handling lasting 83 minutes at Padangtegal, and 31 bouts of object manipulation during "robbing and bartering" for 69 total minutes at Uluwatu. A key difference between these sites is the social context in which these forms of object manipulation occur. At Padangtegal 72% of time spent stone handling is done with at least one neighbor in close (3m) proximity, whereas at Uluwatu only 39% of time handling stolen items occurred within a social context. We argue that the cultural behavior of stone handling at Padangtegal is also a social activity rather than simply a technological or nonfunctional behavior. Our findings suggest that nonhuman primate cultural behaviors may influence social structure in significant ways.

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A child with probable skeletal tuberculosis from a cemetery in Turaida, Latvia (15th – 16th centuries AD)

ELINA PETERSONE-GORDINA[1], GUNTIS GERHARDS[1] and CHARLOTTE A. ROBERTS[2]

[1]Bioarchaeology, Institute of Latvian History, University of Latvia, [2]Archaeology, Durham University

This research focuses on a child from a post-medieval cemetery in Turaida, Latvia, with evidence for destructive bone changes affecting multiple elements of the axial and appendicular skeleton. The child was one of eight individuals uncovered in the summer of 2017. The main aim of this study is to explore the observed pathological bone changes in this child and to propose differential diagnoses.

The age at death of the child was estimated between nine and 10 years, according to dental development. Pathological skeletal changes were observed by macroscopic analysis. The most significant changes affected the right ulna, whereby the proximal articular surface was almost completely destroyed. Similar changes were observed in four lower thoracic vertebrae, T9-T12. Only the vertebral bodies were affected, with most of the body of T11 destroyed. Furthermore, new woven bone was present on the proximal visceral aspects of five left, and four right ribs.

The results of the palaeopathological analysis suggest that most pathological changes observed in this child are consistent with skeletal tuberculosis (TB), with osteomyelitis, septic arthritis and other conditions also considered as differential diagnoses. The advanced nature of the changes suggest that the child contracted the disease in the first years of life. So far, this is the first completely preserved archaeological skeleton from Latvia with changes suggestive of TB involving several axial and appendicular skeletal elements. This study is therefore an important addition to regional and global studies of health, and specific infectious disease in particular.

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Steroid hormone concentrations in milk predict postnatal infant growth in rhesus macaques (*Macaca mulatta)*

LAUREN PETRULLO[1], KATIE HINDE[2,3,4] and AMY LU[5]

[1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [2]Center for Evolution and Medicine, Arizona State University, [3]School for Human Evolution and Social Change, Arizona State University, [4]Brain, Mind, and Behavior Unit, California National Primate Research Center, [5]Department of Anthropology, Stony Brook University

Maternal-origin biochemical signals are transferred to offspring during lactation via milk and program critical aspects of development, including growth. Here, we test the hypotheses that milk cortisol and dehydroepiandrosterone-sulfate (DHEAS) concentrations reflect maternal characteristics and that changes in these hormones across lactation predict infant growth. Data were collected at early, peak, and late lactation from rhesus macaque mother-infant dyads (N = 78) at the California National Primate Research Center in Davis, California. Using linear mixed models, we examined whether maternal traits (e.g., dominance, parity) predicted milk hormone concentrations, with maternal ID as a random effect. We then used multiple regressions to explore how changing milk hormone concentrations predict infant growth, controlling for milk yield and energy density as well as absolute hormone concentrations at early lactation. We found that primiparous females produced milk with lower concentrations of cortisol than did multiparous females (p < .05) and DHEAS concentrations decreased with maternal parity (p < .05). Female growth rates were predicted by changes in cortisol from early to peak (p < .05) and peak to late (p < .01) lactation. However, male growth rates were predicted by changes in DHEAS from early to peak (p < .01) and peak to late (p < .01) lactation. Our results suggest that milk hormones contribute to sex-specific infant growth at different windows of sensitivity. These findings reveal a role for milk DHEAS in early postnatal growth and shed further light on how mammalian offspring may use the components of milk in a sex-specific manner.

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Zygomatic shape among primates

ALESHA PETTIT and BRIAN VILLMOARE

Anthropology, University of Nevada Las Vegas

The zygomatic bone and its physical position, as connected to both the face and cranium, could indicate unique evolutionary trajectories and functions among hominins and primates. Most models that include the zygomatic in analyses focus on it indirectly, with any noteworthy characteristics typically drafted into the more seemingly critical adaptations of the maxilla. Changes to the nasal opening and maxillary sinuses will affect the shape and orientation of the maxilla, and indirectly affect the zygomatic. However, the zygomatic bone might have a more prominent role, independent of the maxilla, in evolutionary changes among primates and hominins, especially considering its proximity to the eye orbit and the muscle structure of the face. The zygomatic bone accounts for a significant portion of the eye orbit, so analyses of possible covariance between the zygomatic and eye orbit are essential to understanding the zygomatic and its relationship to the primate face.

To examine the relationship, to determine if the zygomatic is constrained and/or independent of other parts of the face, multiple facial landmarks were collected from humans, fossil hominins, chimpanzees, gorillas, and orangutans using CT scans and the data collection software Checkpoint. For this study, specific hypotheses include that the zygomatic and orbit shape covary, and zygomatic thickness, orientation, and breadth covary with orbit shape. Results indicate covariance of the orbit shape with these different aspects of the zygomatic bone. Results of either independence and/or covariance will add to further discussion and research regarding the particular evolutionary forces involved in facial morphology among primates.

Dietary sufficiency and bone histomorphometry assessed in rib tissue of Later Stone Age southern African foragers

SUSAN K. PFEIFFER[1], MICHELLE CAMERON[1], JUDITH SEALY[2] and AMY BERESHEIM[1]

[1]Anthropology, University of Toronto, [2]Archaeology, University of Cape Town

Later Stone Age (LSA) southern Africans from Holocene contexts have small adult body sizes. Among western and southern coast foragers, body sizes are transiently more variable between ca. 3500-2000 BP, through the presence of

some very small adults. Dietary composition, as indicated by stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios from bone collagen, does not explain body size variability. Isotopic data may not speak to dietary sufficiency; protein-rich carbohydrate-deficient diets may contribute to systemic acid-base imbalances with implications for bone tissue maintenance. Bone histological analyses may clarify if Type II or double-zonal secondary osteons and rapid remodelling are more prevalent among individuals with acid-base imbalances. Cortical bone variables (total cross-sectional areas, endosteal areas, and % cortical area) and histomorphometric variables (Type II osteons, osteonal areas and perimeters) were analysed in LSA adult mid-thoracic ribs (n=53: 27m, 23f, 3 indeterminate), incorporating body size measures (femur maximum length and head diameter) and stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$). The absolute number of type II osteons increases with chronological age at death. There are no significant differences in the presence or prevalence of type II osteons among individuals who consumed high trophic level diets, as per $\delta^{15}N$ values. There are no significant differences in bone histomorphometric properties among individuals with higher trophic level diets. Percent cortical area decreases as $\delta^{15}N$ increases, indicating that relative cortical area decreases with high trophic level diets. This pattern is driven by increased endosteal resorption evidenced by increased endosteal areas, and is stronger among women.

Dental Diversity and Population Movement in Neolithic Central Anatolia

CASEY S. PHILBIN[1] and MARIN A. PILLOUD[2]

[1]Chemistry, University of Nevada, Reno, [2]Anthropology, University of Nevada, Reno

Early signs of the proto-domestication of plants are arguably visible in the Near East around 12,000 years ago. Within central Anatolia, at the western periphery of the broader zone of early west Asian Neolithization, this sociocultural transformation continued for four millennia (11,000 BCE to 7,000 BCE) before spreading into neighboring regions. This protracted period of time allowed Central Anatolia to develop in unique and differing ways as evinced in the archaeological record. This region may therefore have served a pivotal role in the movement of the domestication of plants and animals and its associated sociocultural complex. This study explores population variation during the Neolithic in this region to understand the creation and movement of these communities.

This study focuses on four key central Anatolian Neolithic sites: Boncuklu Höyük, Aşıklı Höyük, Musular, and Çatalhöyük that span the early aceramic to the later Pottery Neolithic (8500-5950 cal BCE). Dental morphological data were collected (n=549) to calculate various diversity indices: Shannon entropy, Simpson concentration, and Pielou's evenness. Shannon Diversity indicates that Boncuklu is the least diverse, Aşıklı is intermediate in diversity, with Çatalhöyük being the most diverse. Simpson and Pielou indices mirror these results, suggesting that as new traits are introduced, a concomitant decrease in evenness is observed. Overall, populations are becoming more diverse over time. Such findings could indicate there was local development of these communities as evident in the earlier sites, and that over time populations had increased gene flow, perhaps as groups began to aggregate, expand, and move.

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Estimating age-at-death of archaeological remains: A comparison of Transition Analysis and traditional estimation methods

MEGANN PHILLIPS[1], ANNIE LAURIE NORRIS[2] and BRENDA J. BAKER[2]

[1]Department of Sociology and Anthropology, George Mason University, [2]School of Human Evolution and Social Change, Arizona State University

Age estimation of human skeletal remains is fundamental to research in paleopathology, bioarchaeology, and forensic anthropology. Transition Analysis (TA) is an increasingly popular method for estimating age-at-death of adult skeletal remains, but minimal work has been conducted to investigate the inter-method replicability of age estimations produced using TA and traditional methods. While traditional methods often include comprehensive multifactorial analyses of skeletal features, narrow predetermined age intervals usually create age ranges that differ from the Bayesian statistics-based confidence intervals produced with TA. Understanding the differences in age estimates made with TA and traditional methods is important for evaluating the ways in which methods used might affect paleodemographic conclusions.

In this work, 71 individuals from the El-Qinifab School site in northern Sudan were used to study the differences in TA and traditional age estimates. Traditional point estimates of age-at-death previously produced by analysts of varying experience levels were compared to corresponding TA maximum-likelihood estimates produced by one novice and one intermediate-level analyst. The results indicated that TA and traditional estimates were not highly correlated, and TA tended to produce younger age estimates across general categories of young, middle and older adult. This tendency was reflected in a mean paired difference of -6.83 (σ = 12.75) years and bivariate correlation of 0.667 between traditional and beginner-level TA estimates. The difference was exaggerated in middle-aged and older individuals. Additionally, beginner and intermediate TA estimates were variable, suggesting that TA estimations depend upon experience and casting doubt on inter-observer replicability of this method.

Ecoimmunology of wild chimpanzees (*Pan troglodytes schweinfurthii*): Does *MHC* genotype or phenotype predict occurrence of respiratory infection?

SARAH PHILLIPS-GARCIA[1], MELISSA EMERY THOMPSON[1], MARTIN N. MULLER[1], ZARIN P. MACHANDA[2], ERIK SCULLY[3], EMILY OTALI[4], TONY L. GOLDBERG[5], RICHARD W. WRANGHAM[3], PETER PARHAM[6] and EMILY WROBLEWSKI[7]

[1]Department of Anthropology, University of New Mexico, [2]Department of Anthropology, Tufts University, [3]Department of Human Evolutionary Biology, Harvard University, [4]Kibale Chimpanzee Project, Kibale National Park, Uganda, [5]Department of Pathobiological Sciences, University of Wisconsin - Madison, School of Veterinary Medicine, [6]Department of Structural Biology, Stanford University School of Medicine, [7]Department of Anthropology, Washington University of St. Louis

Genes of the *Major Histocompatibility Complex* (*MHC*) in vertebrates encode glycoproteins that recognize and present peptides to immune cells, activating an antigen-specific immune response to those that are foreign. These genes are highly diverse, and diversity is hypothesized to be maintained by pathogen pressure. Utilizing both direct and next-generation sequencing of PCR products, we characterized exons 2 and 3 of the *Class I MHC* gene, *Patr-B*, for 48 members of the Kanyawara community of chimpanzees in Kibale National Park, Uganda. Results were validated through repetitive sampling and known pedigrees, and alleles were screened against the IPD-MHC database. Preliminary results indicate 13 *Patr-B* alleles in Kanyawara chimpanzees, with 42 heterozygotes and 6 homozygotes. Seven alleles are novel, all of which were driven by changes in exon 3. Information on heterozygosity, Bw4 epitopes, and specific alleles were evaluated in concert with 4,456 observations of health – 365 observations were positive for respiratory infection – and linked to demographic parameters like age and sex. Mixed-effects logistic regression was employed to test the hypothesis that immune-related genotypes and phenotypes predict occurrence of respiratory infection in Kanyawara chimpanzees. The best-fit model (chi-square = 104.99, df = 7, $p < 0.001$) revealed two, significant genetic parameters: Homozygous and *B*17:03* positive individuals were 2.5- and 2-times more likely, respectively, to be observed with respiratory infections. The model indicates strong temporal influences dependent on month and year of infection. While heterozygosity is influential over multiple years, it

is likely that particular alleles will be informative in specific outbreaks.

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The PASSER Project: Enhancing Ethological Research on Amazonian Primates via a Semi-autonomous Computerized Feeding Device

CONNER S. PHILSON[1], ANDREW RAY[2], CASSADY Y. URISTA[3] and JASON E. DAVIS[1]

[1]Department of Biology, Radford University, [2]Department of Information Technology, Radford University, [3]Department of Anthropological Sciences, Radford University

Traditional methodology of ethological research fails to collect data on a majority of occurring events due to time limitations of the researcher. Integrating micro-computing into ethology provides a novel method to collect detailed, multi-modal data sets, 24/7/365, thus overcoming many of these limitations. Though this requires a substantial investment of time and technical ability, it offers the benefit of long-term, relatively low-cost, minimally invasive data collection, with limited person-hour investments. Here we describe the development and initial results of the "primate variation" of the PASSER Project (Programmable Automated System for Songbird Ecological Research), and its application to the study of primate feeding behaviors in the Madre de Dios Region of the Peruvian Amazon. In their simplest practice, PASSER feeders allow automated data collection of feeding activity, alongside a variety of environmental metrics (i.e. photos or video, temperature, humidity and time). This allows us to conduct both rapid and long-term surveys of species diversity, as well as studies of behavior-environment interactions for those species. Three feeders were deployed for a two week span inland of the Las Piedras River in the Peruvian Amazon. Feeders saw overall low primate activity, however the most activity was seen in the unit active for the longest time, showing that extending the active time of these feeders will yield activity. We also saw heavy night activity. Because of this, next generation feeders will include infrared cameras to capture this activity. We discuss ongoing implementations and future directions for this type of work.

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New Excavations of Malaria-Affected Victims at Lugnano in Teverina, Italy

DAVID PICKEL[1], DAVID SOREN[2] and JAMIE INWOOD[3]

[1]Department of Classics and the Stanford Archaeology Center, Stanford University, [2]Department of Religious Studies and Classics, and the School of Anthropology, University of Arizona, [3]Department of Anthropology and Archaeology, University of Calgary

This poster presents a preliminary report of new excavations of the *la Villa Romana di Poggio Gramignano* (VRPG) conducted between the Summers of 2016 and 2017 by American and Italian archaeologists. An abnormal infant cemetery (5th cent. CE) likely related to a malaria epidemic event was previously discovered within this villa's storage magazines. These first two seasons are the beginning of a multi-year research project that aims to better understand both the villa and this cemetery.

VRPG, a 1st cent. BCE Roman villa originally excavated in the 1980s and early 1990s, is located along the Tiber river near the Umbrian town of Lugnano in Teverina. Its attendant cemetery contains the remains of at least 47 children, ranging in age from prenatal to three years. Taking into account much material, pathological, and textual evidence, the original excavators suggested that this cemetery was likely the result of an acute malaria epidemic. Subsequent analysis of the oldest individual (B36) utilizing more precise analyses - aDNA extraction and hemozoin isolation - corroborate this interpretation: B36 most likely died from an infection of *Plasmodium falciparum* malaria, the most malignant strain of the disease.

VRPG provides the rare opportunity to better understand the history of malaria in its historical and paleo-environmental context. This poster sets VRPG within the long history of malaria in Italy, and presents the results of both 2016 and 2017 excavation campaigns, with particular focus on the variegated bioarchaeological research being done regarding mortuary practice and disease history.

Geology and uranium-lead (U-Pb) dating of the South African *Paranthropus*-bearing cave deposits

ROBYN PICKERING

Department of Geological Sciences, University of Cape Town, South Africa

Paranthropus is one of the best represented hominin taxa, with species found in East and South Africa. The South Africa record of hundreds of specimens is preserved in caves in the Bloubank Valley, Gauteng Province. These caves preserve two rock types: fossil bearing sediments, referred to as beccias, and cave carbonates or speleothems, often expressed as horizontally bedded layers, known as flowstones. The lack of absolute ages for the South African sites has left this record being viewed as a 'poor cousin' to the East African sites. Recent research into the flowstone layers holds the key to changing this. Flowstones are ubiquitous features at all the sites and serve the dual utility of providing ages for the fossilferous sediments sandwiched between them (via U-Pb dating) and as indicators of past climate regimes by their presence alone, being associated with increased effective precipitation. The *Paranthropus*-bearing sites of Swartkrans, Drimolen and Cooper's have all been dated via U-Pb and provide a new age range of ~2.2 to ~1.4 Ma. There is a pattern between the U-Pb dated flowstones across the sites: specific time periods are represented by flowstones in several caves, meaning that the fossil bearing sediments from these sites can now be correlated with each other. The strong external forcing on the formation of flowstones is most likely an increase in rainfall. The presence of *Paranthropus* fossil on either side of several thick, inter-cave flowstones suggests that in South Africa *Paranthropus* survived several significant wet phases.

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Figs are important, but not fallback foods for chimpanzees in the Issa Valley, Tanzania

ALEX K. PIEL[1], ADRIENNE CHITAYAT[2], PAOLO STRAMPELLI[3] and FIONA A. STEWART[1]

[1]Natural Sciences and Psychology, Liverpool John Moores University, [2]Faculty of Science, University of Amsterdam, [3]Wildlife Conservation Research Unit, University of Oxford

Chimpanzees often respond to periods of low fruit availability by shifting their diets to include lower-quality "fallback foods", usually more readily available throughout the year. Fallback food consumption influences population density, as well as overall ecology and evolution. Numerous studies have discussed the importance of figs (*Ficus* sp.) as a fallback food for chimpanzees, but not necessarily for all populations, as some communities consume figs year-round. We investigated the role of figs in the diet of the Issa Valley chimpanzees, a community that lives in a miombo woodland mosaic habitat of western Tanzania. We macroscopically analysed 950 chimpanzee feces samples over 50 months and found that figs were the most frequent plant consumed in that period (40/41 months with at least 5 samples). Overall, 40% of samples contained *Ficus* seeds, and sometimes every sample for an entire month. Consumption was not associated with overall fruit availability ($r=0.31$, $n=27$, $p=0.10$) or seasonality ($U=135$, $p=0.13$). We compare *Ficus* species diversity and distribution at Issa as well as the role of figs in

forest versus savanna-dwelling chimpanzees and the implications for savanna living.

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Dental diversity in *Pongo* as revealed by molar occlusal morphometrics

VARSHA PILBROW

Anatomy and Neuroscience, The University of Melbourne

The Asian Great Ape, Orangutan (Genus *Pongo*, Family Hominidae), is the last survivor of a large proliferation of Miocene and Plio-Pleistocene apes in Europe and Asia. As such, the nature of dental diversity in *Pongo* is of great relevance for understanding patterns of dental diversity in fossil apes and humans. With the preponderance of molars in the hominoid fossil record, the purpose of this study is to document dental diversity in *Pongo* by classifying the known subspecies and species using molar occlusal morphometrics.

Using standardized and calibrated two-dimensional photographs of the occlusal surface of molars, linear dimensions and cusp crest lengths were measured on a sample of 165 molars of known provenance (*P. pygmaeus pygmaeus* = 97; *P. p. wurmbii* = 39; *P. p. morio* =4; *P. abelii* = 25). Overall sex break-down was 44% males and 56% females.

Results of independent samples t-test reveal that molar linear dimensions are significantly greater in males than females, suggesting that sexual dimorphism is an important aspect of dental diversity in orangutans. In linear discriminant analysis, *P. abelii* is classified with an average accuracy of 78% on the first two molars, but 52% on the lower molars, verifying the distinction of the Sumatran species, particularly on the anterior molars. The subspecies, *P. p. wurmbii* and *P. p. pygmaeus* are classifiable with 66% and 60% accuracy, respectively, indicating that the River Kapuas may present a biogeographic barrier. Sample sizes for *P. p. morio* were too small to draw meaningful conclusions on distinction or affinity.

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Outlining a Definition of Oral Health within the Study of Human Skeletal Remains

MARIN A. PILLOUD[1] and J.P. FANCHER[2]

[1]Anthropology, University of Nevada, Reno, [2]Anthropology, Texas State University, San Marcos

Defining health in past populations, or even the recently deceased, can be difficult as this concept incorporates somewhat unknowable factors about lifestyle. These critiques about general health can be taken more specifically to the notion of "oral health." While the clinical definition of oral health includes conditions of the oral cavity that are detrimental to one's general quality of life, within bioarchaeological research this definition can vary widely. This variation is illustrated in a survey of articles published in the American Journal of Physical Anthropology, International Journal of Osteoarchaeology, and the International Journal of Paleopathology. Those articles that use the term "dental health" or "oral health" in the title or abstract (n=44) can include analyses on any number of pathological conditions such as dental caries, antemortem tooth loss, occlusal wear, calculus deposits, periapical lesions, periodontal disease, hypercementosis, pulp cavity exposure, dental chipping, and/or linear enamel hypoplasia. Within this body of literature there is little consensus on what factors should be studied as part of oral health and may also employ varying definitions of these pathological conditions.

This paper proposes to address inconsistencies and misconceptions in studies of oral health on skeletal remains. To this end, conditions appropriate to include as part of studies on oral health based on the clinical literature are outlined, which include carious lesions, antemortem tooth loss, periodontal disease, periapical lesions, among other pathological conditions. Definitions and clinical etiologies for these conditions are also discussed as relevant to bioarchaeological studies.

The evolution of tolerance in non-human primates and humans

ANNE C. PISOR[1] and MARTIN SURBECK[2]

[1]Department of Human Behavior, Ecology, and Culture, Max Planck Institute for Evolutionary Anthropology, [2]Department of Primatology, Max Planck Institute for Evolutionary Anthropology

The evolution of intergroup aggression and warfare has received much recent attention in physical anthropology. However, there is extensive variability in behavior in intergroup encounters across species, within species, and within individuals; this includes tolerant behavior, the glue that holds multilevel societies together. What are the selection pressures that favor the expression of tolerance in intergroup encounters in the Primate order, and can understanding these pressures allow us to make predictions about non-human great ape and human intergroup behavior? We predict that individuals should exhibit tolerance in intergroup encounters when incentives for contest are low and incentives for encounter are high; reviewing the non-ape primate literature, we identify existing theoretical approaches that address when these conditions should hold. Turning to the great apes, data indicate that tolerance is a behavior exhibited in intergroup encounters in gorillas, bonobos, and (especially) humans. However, we suggest that the existing theoretical literature does not sufficiently address why tolerance is common in these species. In gorillas and bonobos, we suggest that more data are needed, while in humans, we highlight how the human diet may have increased incentives for extended encounters to buffer risk and gain access to non-local resources, connections solidified and built upon by cultural institutions. We conclude by indicating the types of data that are needed to better theorize about this domain of primate societies.

Thick enamel, thin bone: a common link in human juvenile hard tissue growth?

ROSIE PITFIELD, CHRIS DETER and PATRICK MAHONEY

School of Anthropology and Conservation, University of Kent

The Havers-Halberg oscillation hypothesis (HHO) proposes that an underlying biorhythm may have a role in hard tissue growth, in relation to body size and life history, when compared between some mammalian species. Recent studies explored this hypothesis within adult humans, revealing attained stature and final permanent molar enamel thickness related to the biorhythm. This study searches for evidence of a link between cortical bone width and enamel thickness, in a sample of human juvenile skeletons (n=45) aged between three to 13 years of age. Histological thin sections were removed from the anterior mid-shaft region of the humerus, and from the permanent first maxillary molar of each skeleton. Cortical width and 2D average enamel thickness were measured from thin sections using Cell Sens image analysis software. Analyses revealed a significant and negative correlation ($p=0.008$) between enamel thickness and cortical width when the sample was subdivided into age groups. Thus, children with thicker molar enamel generally had thinner cortical bone, though this correlation was much stronger in the older children. These preliminary findings demonstrate a potential age-related link between enamel and bone growth in human children. Ongoing PhD research will examine these measures of enamel and bone thickness against evidence of a biorhythm retained in tooth enamel, and the underlying cellular mechanisms responsible for the morphology of hard tissue in these children.

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Testing the impact of culturally-transmitted dietary norms on hemoglobin levels during critical developmental periods

CAITLYN PLACEK[1,3], VIJAYA SRINIVAS[2], POORNIMA JAYAKRISHNA[3] and PURNIMA MADHIVANAN[3,4]

[1]Anthropology, Ball State University, [2]Gynocology, Public Health Research Institute of India, [3]Women's

Health, Public Health Research Institute of India, [4]Epidemiology, Florida International University

Accumulating evidence suggests that culturally-transmitted food taboos and dietary norms serve functional benefits, such as providing protection for pregnant women and their developing fetuses. Empirical evidence for these purported outcomes, however, are lacking. Meat avoidances, for example, could lower hemoglobin levels, which might serve a pathogen-protection role. Alternatively, these evolved social norms could be maladaptive in cases where they lead to nutritional deficiencies, especially during critical developmental periods, such as adolescence and pregnancy. The current study investigates the link between socially-acquired dietary norms and hemoglobin levels among pregnant women and adolescents. Data were collected from the *Jenu Kurubas,* a Scheduled Tribe located in Mysore, Karnataka, India. Data for pregnant women (n=30) were collected over an 8-week period in 2016, and data from adolescent participants (n=75) were collected over a 4-week period in 2017. Participants in both cohorts completed structured interviews and provided a finger prick of blood to assess iron levels. Socially-acquired dietary norms included specific food taboos (such as meat), vegetarianism, religious fasting, and frequency of meat avoidances for religious purposes. Findings suggest that socially-acquired dietary norms during these critical periods of development are associated with lower iron levels during pregnancy, and iron deficiency anemia among adolescent girls.

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Modeling the Genetic, Epigenetic, and Neural Mechanisms Mediating Variation in Complex Human Social Behavior in Rhesus Macaques

MICHAEL L. PLATT

Neuroscience, Psychology, and Marketing, University of Pennsylvania

Recent studies have identified causal genetic contributions to autism and other disorders. Yet our ability to determine the genetic causes of any human disorder in mouse models, though powerful at the molecular and synaptic level, is limited by differences in behavior and relevant neural circuitry. To address this gap, we employ an integrated approach, in which we characterize the genetic, epigenetic, and neural causes and consequences of variation in social behavior in free-ranging macaques, and in parallel determine the neural mechanisms that mediate complex social behaviors in the lab. We then leverage this macaque model to evaluate potential therapies for social impairments in ASD, including oxytocin and transcranial magnetic stimulation. I will describe the current state of these efforts, which builds upon our prior work demonstrating conservation of complex human social behaviors (including visually-guided social reward, joint attention, empathy, and strategic decision making) in rhesus macaques, heritable variation in some of these behaviors, the neurobiological basis of these behaviors, and their sensitivity to exogenous oxytocin. I will conclude with our plan to map the gene regulatory landscape in brain areas implicated in social behavior in hundreds of free-ranging macaques using high-throughput sequencing methods in order to identify gene regulatory signatures that co-vary with social and cognitive abilities, receptor densities within and structural connectivity between key brain areas, and whole-genome sequence data on each animal. This integrative approach offers new potential for deeper understanding of the genetic and environmental contributions to human-relevant social phenotypes at the molecular, structural, and functional levels.

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Phylogeny and sexual dimorphism in primate evolution

J. MICHAEL PLAVCAN

Anthropology, University of Arkansas, Fayetteville

Anthropoid primates show strong degrees of sexual dimorphism in the canine teeth and in body size. The degree of dimorphism in fossils often plays an important role as evidence for male mate competition and various social systems and behavior. Variation in dimorphism, though, is a function of variation in both male and female traits. Changes in how dimorphism is produced may be more informative than the simple magnitude of the trait. Data on body mass and craniodental dimensions were collected for 185 primate taxa. Primate phylogeny was taken from 10K trees. Sexual dimorphism in body and canine size, and several measures of relative male and female canine size were calculated for each taxon. Character evolution was traced using parsimony in Mesquite. Low degrees of dimorphism are primitive for primates, but modest canine and body size dimorphism are derived anthropoid traits. There are several instances of the loss or enhancement of dimorphism among primates, and apes illustrate pattern variation well. Low degrees of dimorphism are derived for hylobatids. Assessment of male and female traits independently clearly shows that the loss of dimorphism in hylobatids is from an increase in female canine size. Great apes generally show reduction in both male and female canine size, but derived size dimorphism. Similar variation is seen in various platyrrhines, strepsirrhines, and cercopithecoids. The implications for hominins in particular are that size and canine dimorphism are decoupled, consistent with a model of a complex history of gain and loss of dimorphism among hominins.

Refining Asian Ancestry Classifications via Cranial Macromorphoscopic Traits

AMBER M. PLEMONS, JOESPH T. HEFNER and KELLY R. KAMNIKAR

Anthropology, Michigan State University

Forensic anthropologists frequently use 3-group classification models for ancestry estimation. However, delineation of 'Asian' classification is complex, due to human migration patterns and greater variation within these groups who represent various geographic origins. These groups include mainland Asians, Pacific Islanders, Native Americans, Eskimos, and Hispanics. We explore potential refinement of Asian ancestry classifications based on cranial macromorphoscopic traits.

The Macromorphoscopic Databank (MaMD) is data repository for cranial macromorphoscopic traits for use with bioarchaeological and forensic human skeletal remains. This study explores biological distance via cranial morphology between Native American (NA), Eskimo, and several Southeast Asian populations. Canonical Analysis of the Principal Coordinates (CAP) using the chi-square distance metric was used to compare NA, Eskimo, and Asian individuals through canonical and discriminant analysis. Classification accuracies ranged from 83.8% (Asian) to 31.6% (Eskimo). Previous research has strongly correlated biodistance and geographic barriers; therefore, we tested within the NA sample using a pooled sample identifying seven geographic regions. The highest classification accuracies were for the Southeastern sample (58%) followed by the Midwest (52%). Finally, we compared several finer-levels of resolution to determine the effectiveness of these geographic parameters. Aleut (71.9%) had the highest classification, followed by Arikara (60%), and Pueblo (59.65%). Biodistance analysis will be presented to demonstrated group relatedness for each phase of analysis.

These results highlight difficulties distinguishing between groups broadly classified as Asian (Asian/NA/Eskimo), although increased classification rates are possible on a more refined level. Biological distances indicate these traditional 3-group systems of classification are outmoded and require further refinement.

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Preparing natural history museum volunteers to engage with visitors about climate change and evolution

BRIANA POBINER[1], JENNIFER COLLINS[2] and TRISH MACE[3]

[1]Anthropology, Smithsonian Institution, [2]Education and Outreach, Smithsonian Institution, [3]Oregon Institute of Marine Biology, University of Oregon

Natural history museums are repositories of collections, research data, and exhibits that often focus on climate change and evolution; and public-facing volunteers in those museums are on the front lines of public engagement on these two potentially controversial topics. Here we present the results of a study on professional enrichment for volunteers at the Smithsonian's ational Museum of Natural History to increase their effectiveness and comfort level engaging with museum visitors about climate change and evolution. Participants were invited to complete a survey before, immediately after, and 8 months after the training to assess which of the enrichment approaches and visitor engagement techniques they anticipated would be most useful, and which they actually found to be useful. Both immediately and 8 months after the session, volunteers found the institution's official statements on climate change and evolution the most useful piece of information they received, and a presentation of strategies informed by social science research for productive discussions related to these topics (e.g. identifying and starting from common values, using clear words and avoiding jargon, using metaphors to help explain complex processes, avoiding "polarized identity" thinking) the most useful skills-building exercise. Group discussions, brainstorming possible difficult situations and their solutions, and watching or participating in role playing were deemed less useful. Based on these results we suggest that familiarity with social science research on communication strategies for dealing with potentially difficult interactions around these topics would be a beneficial tool for biological anthropologists seeking to engage with broader public audiences.

Natal Dispersal and Offspring Behaviour in the Javan slow loris (*Nycticebus javanicus*)

STEPHANIE A. POINDEXTER[1,2] and K. A. I. NEKARIS[1,2]

[1]Nocturnal Primate Research Group, Oxford Brookes University, [2]Little Fireface Project, Indonesia

Natal dispersal affects the demography and structure of a population, genetically and socially. It is suggested that individuals disperse to avoid inbreeding with relatives, to minimize competition for mates, or to gain access to environmental resources, such as food. Following these hypotheses, a number of factors may initiate dispersal in the Javan slow loris (*Nycticebus javanicus*). To address which of these are most salient, we look at social interactions and dispersal events present in a five-year dataset we collected in Indonesia. This dataset includes the spatial, behavioural, and demographic data collected at the Little Fireface Project field site located in West Java between 2012 and 2017. We found that within the natal group the most observed behaviours between offspring and group mates, were play (43.5%) and allogrooming (23.5%). Home range sizes ranged between 0.21-7.1 ha. in offspring, 1.7-12.7 ha. in mothers, and 3.5-19.9 ha. in fathers. Both males and females dispersed between 18-26 months of age, travelling between 628-1368 m outside of the natal home range. Mature Javan slow lorises actively engage with offspring, including birth mothers, fathers and dispersed siblings. Older siblings within the natal home range can be categorized as helpers as they overlap with new offspring temporally and spatially prior to dispersal. Age at dispersal and dispersal distance highlight the potential importance of kinship associations established during offspring development within their natal home range. These data also show that the presumed age of sexual maturity derived from captive studies may not hold true in the wild.

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The effects of early nutrition transition on growth trajectories and child productivity among the Hadza of Tanzania

TREVOR POLLOM[1], KRISTEN HERLOSKY[1], IBRAHIM MABULLA[2], CHAD CROSS[3] and ALYSSA CRITTENDEN[1]

[1]Anthropology, University of Nevada, Las Vegas, [2]Archaeology and Heritage, Dar es Salaamn, Tanzania, [3]Medicine and Community Health, University of Nevada, Las Vegas

The Hadza foragers of Tanzania are rapidly transitioning into more sedentary lifestyles with an increasing level of market integration. Accompanying these shifts is a significant change in diet composition with greater access to corn, wheat, and other domesticated cultigens, even in the most remote bush camps. These dietary shifts are multifactorial – linked to both resource depletion and increased interactions with missionaries, non-profit organizations, government subsidies, and ecotour operators. Despite the rapid rate of these transitions and their ubiquity in Hadza territory, most recent studies seldom address the effects that such a transition have on health and behavior. Here, we used a mixed-methods approach to begin baseline investigations into the effects of transition on the health and productivity of juvenile Hadza foragers. We compare anthropometric measurements and recorded food returns for a sample of young Hadza foragers from two time points, 2005 and 2017. Our results indicate that Hadza children and juveniles in 2017 are consuming a mixed diet of both wild foods and domesticated grains and exhibit overall less stunting than in 2005 using World Health Organization growth trajectories. These data are critical for understanding the directionality of Hadza health as they transition away from their traditional foraging lifestyle. Work of this nature may provide an important framework for understanding the effects of transition on human health, and may act to inform aid organizations as they assist the Hadza or similarly marginalized populations.

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Relationship of hip and knee joint angles to leaping in two African colobine species

TAYLOR A. POLVADORE[1], FERDINAND OUORO[2], DAVID J. DAEGLING[1] and W. SCOTT MCGRAW[3]

[1]Department of Anthropology, University of Florida, [2]Behavioral Assessment, Taï Monkey Project, [3]Department of Anthropology, The Ohio State University

Although the kinematics of bounding are poorly understood, this form of saltatory locomotion is often categorized as a "subset" of leaping. *Piliocolobus badius* and *Colobus polykomos* are similarly-sized cercopithecids and both are accomplished leapers; however, only the king colobus engages in bounding quadrupedalism. *C. polykomos* possesses traits (low intermembral index, large femoral head, long femur, acute femoral angle) suggesting it should leap more than *P. badius*, but field data indicate this is only true if bounding is defined as leaping.

Investigation of joint angles during locomotion gives insight into the required accelerations for bounding and leaping. We investigate variation in hip and knee joint angles at take-off during leaping in *Colobus polykomos* and *Piliocolobus badius* and during bounding in *C. polykomos*. Our null hypothesis is similarity of knee and hip angles during leaping in both species and bounding in the king colobus.

Videos were taken of habituated individuals of both species in Taï Forest, Côte d'Ivoire from June-August, 2016. Frame by frame analysis identified the point of take-off during leaping and bounding. We quantified hip and knee joint angles from in-plane and nearly in-plane (< 10°) stills. The hip angles of *C. polykomos* and *P. badius* during leaping do not differ ($P = 0.55$), but knee angles do ($P = 0.02$). Within *C. polykomos*, hip and knee angles differ between bounding and leaping ($P < 0.001$). These findings suggest that bounding in *C. polykomos* involves unique kinematics and

that this behavior should not be biomechanically conceptualized as a leaping subcategory.

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Feasibility of estimating total body, lean and fat mass from bone cross-sectional geometry

EMMA POMEROY[1], ALISON MACINTOSH[2], JONATHAN C.K. WELLS[3], TIM J. COLE[3] and JAY T. STOCK[2]

[1]School of Natural Sciences and Psychology, Liverpool John Moores University, UK, [2]Department of Archaeology and Anthropology, University of Cambridge, UK, [3]UCL Great Ormond Street Institute of Child Health, University College London, UK

Lean and fat mass were likely under different selective pressures during human evolution, and may have followed distinct evolutionary trajectories. The ability to estimate these characteristics from skeletal properties would offer significant insight into the evolution of phenotype, the nature and timing of selective pressures, and the origins of contemporary variation in body composition and associated disease risk. We investigated the potential for estimating lean, fat and body mass from limb bone cross-sectional properties in a sample of young adult female athletes and controls (n=113). Peripheral quantitative computed tomography (pQCT) was used to derive cross-sectional areas, cross-sectional geometry and external dimensions of the femur, tibia and humerus midshafts. Body composition was estimated from bioimpedance analysis (lean and fat mass) and anthropometry (muscle mass). Lean and muscle mass were most closely related to bone properties (Pearson correlation r values up to 0.74 and 0.69 respectively), but the correlation with fat mass was weak ($r \leq 0.29$). The strength and pattern of correlations between body mass or its components and different properties were similar across all bones. Sample estimation equations derived for tibial midshaft properties demonstrated that muscle and lean mass could be estimated reliably, body mass was more poorly predicted and fat mass prediction was unreliable (minimum standard errors of estimate = 6%, 9%, 12% and 33% respectively). The results suggest that lean and muscle mass can be reliably predicted from long bone cross-sectional properties in our sample, with implications for understanding the basis of the relationship between body composition and bone morphology.

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Comparison of the patterns and degrees of sexual dimorphism among crania from late 19th to early 20th century West Africans, African Americans, and European Americans

MELISSA A. POPE[1], ANNA C. RIVARA[2] and ERIN H. KIMMERLE[1]

[1]Anthropology, University of South Florida, [2]Anthropology, University of Notre Dame

Humans exhibit moderate-to-minimal, and population-specific variance of sexual dimorphism, despite significant size differences between sexes. Nutritional and environmental stresses often influence the degree of sexual dimorphism-especially in the crania. Populations with restricted nutritional access are expected to exhibit less sexual dimorphism.

We tested the degree and patterns of sexual dimorphism in the crania of West Africans, African Americans, and European Americans that lived in the late 19th to early 20th century. We hypothesized that the degree of sexual dimorphism would be reduced in West Africans living under colonial imperialism compared to marginalized, low-income U.S. populations.

West African data were collected from three museums (male=87; female=47). African-Americans (male=48; female=59) and European Americans (male=22; female=53) were obtained from the Terry collection. The index of sexual dimorphism (ISD) for seven standard measurements of vault and facial dimensions was calculated for each population. We analyzed the ISD values between populations; correlation analyses of the ISDs quantified the degree of similarity in sexual dimorphism patterns for each population.

The populations did not significantly vary in their degree of sexual dimorphism ($p>0.05$), likely due to size overlap between males and females, and high nutritional stress levels in all sampled populations. The populations were also not significantly correlated ($p>0.05$), suggesting that the overall pattern of sexual dimorphism is unique to each population, and due to genetic and environmental contributions. This research contributes both to practical applications of measuring sexual dimorphism to identify historical stresses, and to theoretical debates on craniometric population variation.

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Identity in colonial Himera: An assessment of nonmetric dental variation between grave styles

ALEXANDER R. POSTON[1], BRITNEY KYLE[2], LAURIE J. REITSEMA[3], STEFANO VASSALLO[4] and PIER FRANCESCO FABBRI[5]

[1]Classics, Reed College, [2]Anthropology, University of Northern Colorado, [3]Anthropology, University of Georgia, [4]Archaeological Heritage Section, Superintendence of Palermo, Italy, [5]Cultural Heritage, Universita del Salento

Himera was an intersection for indigenous Sicilians, Euboean colonizers, and Corinthian-descended Syracusans, among others. We investigate the relationship between biological ancestry and cultural expression by examining flexed burials and *a cappuccina* graves. In other contexts, flexed burials are tentatively associated with indigenous Sicilians, while *a cappuccina* grave style was a late Archaic custom that originated in mainland Greece. We hypothesize no biological difference between *a cappaccina* and flexed grave types. Biodistance analyses of 24 nonmetric dental traits were used to identify genetic relatedness between Himeran *a cappuccina* (n=264) and flexed samples (n=19). The Himerans were compared with samples from Karystos (n=84, on Euboea) and Corinth (n=43), to see if *a cappuccina* burials are more closely related to individuals from mainland Greece. Pseudo-Mahalanobis' D^2 and logistic regression analysis estimated that Himeran *a cappuccina* and flexed samples were more closely related to each other than to Karystos or Corinth. However, low phenotypic diversity among all four groups suggests all are genetically similar. Similarity between the Himeran samples suggests the possibility that biological ancestry was not a primary factor in the Himerans' conception of cultural identity. Gene flow between a variety of peoples from throughout the Mediterranean could have created a Himeran population that was uniquely Himeran, rather than strictly Greek. This pattern invites a comparison with future biodistance research of the population from Classical Athens, where citizens purport discrimination along biological lines to strengthen Athenian identity against other city-states. The comparison could lend itself to discussions of ethnogenesis in the Greek Mediterranean.

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An evolving national conversation on human evolution

RICHARD POTTS

Human Origins Program, Smithsonian Institution

In 2015, a Smithsonian team (R.P., Briana Pobiner, Connie Bertka, James Miller) initiated a 2.5-year human evolution tour to 19 U.S. communities by

situating the traveling exhibit "Exploring Human Origins" in local libraries. The goal was to extend the content and conversational philosophy of the Smithsonian's Human Origins Initiative across the U.S. The project encouraged audiences to examine fossils and other scientific evidence concerning human evolutionary history. The theme of the exhibit and associated science programs, community and clergy conversations, and educator workshops was the question, "What does it mean to be human?" This question encouraged audiences to offer personal answers as informed by life experiences and religious, moral, and other cultural starting points, and to consider how scientific discoveries may articulate with these understandings.

Over 218,000 visits to the exhibit and related public events were recorded. Surveys at each library and direct interviews (Slover Linett Audience Research, Chicago) independently assessed people's experiences of human evolution content in relation to prior views. While most attendees were motivated by scientific understandings, 30% self-identified as holding non-scientific beliefs about human origins. Nonetheless, on content questions (N=13), 92% were answered in agreement with scientific information by a larger percentage than the relative number of science enthusiasts. A significant majority of all categories of visitors stated that faith-based worldviews can coexist with the idea of human evolution. A tone of respectful conversation consistently helped community members, including clergy, express an openness to a better understanding of human evolution.

Project supported by the John Templeton Foundation and the Peter Buck Fund for Human Origins Research (Smithsonian).

Detecting migration and admixture in South African Holocene human crania

LAUREN L. POWELL[1] and REBECCA R. ACKERMANN[1,2]

[1]Archaeology, University of Cape Town, [2]Archaeology, Human Evolution Research Institute

Until approximately 2000 years ago, all occupants of South Africa were hunter gatherers (San). Thereafter we see archaeological evidence suggesting that there were different coexisting life-ways, including hunter-gathering, herding and farming, due to two major migrations in to the region: the herder (Khoe) migration in the west, and the Bantu-language-speaker migration in the east. There has been considerable debate around whether herding life-ways initially entered the country ca. 2000ya through cultural diffusion or human migration. Additionally, our understanding of admixture at the frontier of the Bantu-language-speaker migration is limited. This study examines variation in crania pre- and post-2000 BP, in an attempt to identify morphological indicators of genetic admixture. These crania are also being analysed using ancient DNA techniques, and our ultimate goal is to link the results here with known ancestry from DNA. 48 Holocene human crania were Micro CT scanned. Three-dimensional landmarks were collected from across the skull. Mahalanobis distances and Principal Coordinate Analyses were used to examine variation across the sample; Procrustes shape analyses were also performed. Results show an inter-individual increase in variation in the craniofacial region after ca.2000 BP. Although pre-2000 BP individuals are fairly homogenous in shape, Procrustes analyses identify individuals with clear evidence of admixture (or at least divergent morphologies) post-2000 BP. Future research will more clearly link these morphological results with evidence from the genotype in order to understand genotype-phenotype associations, and contribute to our understanding of the effects of admixture on morphology

This project was funded by the National Research Foundation of South Africa, DST/NRF Centre of Excellence in Palaeosciences (CoE-Pal).

Anatomical Network Analysis of the musculoskeletal system of the primate head and neck

VANCE C.R. POWELL[1], RUI DIOGO[2], BORJA ESTEVE-ALTAVA[3], JULIA MOLNAR[4], BRIAN VILLMOARE[5] and ALESHA PETTIT[5]

[1]Center for the Advanced Study of Human Paleobiology, The George Washington University, [2]Department of Anatomy, Howard University college of Medicine, [3]Structure and Motion Lab, The Royal Veterinary College, [4]Department of Anatomy, New York Institute of Technology, [5]Department of Anthropology, University of Nevada

Network theory is a powerful framework that quantifies connections (links) between parts (nodes). Network theory has been used to understand, for instance, the structure of social relationships, brain connections, and underlies the functional organization of the internet. Recently, we and our colleagues applied these methods to address modularity and integration among musculoskeletal structures. Anatomical Network Analysis (AnNA) is increasingly used to study anatomy because it allows unique means of analyzing topological relationships not quantifiable with traditional shape-based morphometrics. In particular, AnNA allows quantitative comparisons between structures of different developmental origins, anatomical regions, and diverse tissues.

We present the first AnNA of the musculoskeletal structures in the heads and necks of 22 genera representing all major extant primate groups and their closest relatives. We evaluate hypotheses that the evolution of human facial expressions and vocal communication was accompanied by increased structural complexity. Rather than indicating increased human facial and laryngeal modular complexity, we found decreased modular complexity and density. Results imply that human asymmetrical facial expressions evolved among complex and asymmetrical musculoskeletal facial module organization already present in the hominoid last common ancestor. However, humans have more facial muscles included into modules than any other extant primate. Interestingly, AnNA showed that network organization of laryngeal architecture is not significantly different from that of other primates, supporting the systems biology idea that network plasticity might allow similar networks to display substantially different functions. Importantly, our results also show that multiple network parameters vary according relatedness, indicating that AnNA can recover phylogenetic signals.

Hiding in the dark: discovering cryptic species within nocturnal galagids

LUCA POZZI[1] and MARCO GAMBA[2]

[1]Department of Anthropology, UT San Antonio, [2]Department of Life Sciences and Systems, University of Torino

Describing primate biodiversity is one of the main goals in primatology. Species are the fundamental unit of study in phylogeny, behavior, ecology, and conservation. Though critical, our understanding of how gene flow among taxa can become restricted remains incomplete. Identifying species boundaries is particularly challenging for nocturnal taxa where only subtle morphological variation is present. Traditionally, vocal signals have been used to identify species within nocturnal primates: species-specific signals often play a critical role in mate recognition and they can restrict gene flow with other species. However, little research has been conducted to test whether different "acoustic forms" are also genetically distinct and represent distinct species.

Here, we investigate species boundaries in a highly cryptic complex, the Eastern dwarf galagos (*Paragalago*). Both vocal and genetic data for multiple individuals were collected from ten localities across Kenya and Tanzania. Genetic data include both mitochondrial and nuclear loci (>9kbp), while vocal data include over 200 vocalizations. We use a two-step approach including discovery and validation methods under a coalescence framework, and we then compare the genetic results with bioacoustic data.

Acoustic analyses showed a relatively high level of correct assignation to the putative species (~80%), while genetic analyses show a deep divergence between the two species. We conclude that *P. cocos* and *P. zanzibaricus* represent two valid cryptic species that probably underwent speciation in the Mid-Pliocene (~3.5 Ma) while fragmented in isolated populations in the Eastern forests. Finally, we explore the mechanisms

involved in reproductive isolation and speciation within this cryptic complex.

Multivariate analysis of foot proportions in *Ardipithecus ramidus*

THOMAS C. PRANG

Center for the Study of Human Origins (CSHO), Department of Anthropology, New York University, New York Consortium in Evolutionary Primatology (NYCEP)

The ancestral condition from which humans evolved is critical for understanding the adaptive origin of bipedal locomotion. Foot morphology is thought to reflect primate locomotor adaptations and it provides convincing evidence for bipedalism in early hominins. The earliest hominin partial foot is attributed to *Ardipithecus ramidus* and is argued to show that the foot of the *Homo-Pan* last common ancestor (LCA) was substantially less specialized than that of any living hominoid. Here I analyze the foot proportions of *Ar. ramidus* among a sample of 34 extant taxa (N = 383) to test the hypothesis that humans evolved from an ancestor that was more generalized than the African apes. A Principal Component Analysis (PCA) on six geometric mean-standardized variables (talar trochlea length, talar neck length, cuboid length, first metatarsal length, fifth metatarsal length, and fourth proximal phalanx length) shows that extant taxa clearly separate along hypothesized axes of morphological variation. A cluster analysis on the multivariate data shows that *Ar. ramidus* is most similar to *Pan* and *Gorilla* species in intrinsic foot proportions (cophenetic correlation coefficient = 0.82). Ornstein-Uhlenbeck (OU) models were used to test alternative adaptive hypotheses for foot proportions among the extant primate sample and to evaluate the functional-adaptive implications of an African ape-like foot in the LCA. The best fitting model suggests that the primary adaptive signal in African ape foot proportions is related to terrestrial plantigrade quadrupedalism. This study provides strong evidence that humans evolved from an ancestor with an African ape-like foot.

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A novel, age-structured model of the evolution of economic preferences

MICHAEL H. PRICE[1] and JAMES H. JONES[2]

[1]SFI, Santa Fe Institute, [2]Earth System Science, Stanford

Should a forager hunt for sand monitor lizards or hill kangaroo? Should a peasant farmer intensify cultivation of a nearby garden plot or spread effort across two geographically distinct plots? Should a woman wean her infant and have another baby or continue nursing and delay reproduction? Should an individual buy or rent a home? These are decisions that involve both risk and trade-offs across time. Furthermore, they have clear consequences for reproductive success and survival. We describe a novel model of the evolution of economic preferences that helps explain why people make the decisions they do when faced with trade-offs involving risk and time. Our model extends seminal work by Alan Rogers and combines economic utility theory with age-structured life history theory to predict individuals' risk and time preferences as a function of sex and age. Our model shows that the Marginal Rate of Substitution (MRS) for decisions affecting demographic rates at ages i and j depends on four demographic measures: (1) ratio of reproductive values (or elasticities) at the ages where the allocation trades off, (2) survival from i to j, (3) mean fitness of the population, and (4) the ratio of the marginal change of the vital rates. The first three of these all account for different aspects of time preference, while the first and last account for magnitude of the effect.

When Biocultural isn't Enough: the Evolutionary Becomings of Skulls

JULIA R. PRINCE-BUITENHUYS[1], AGUSTIN FUENTES[1], SUSAN GUISE SHERIDAN[1] and MATTHEW J. RAVOSA[1,2,3]

[1]Anthropology, University of Notre Dame, [2]Biological Sciences, University of Notre Dame, [3]Aerospace and Mechanical Engineering, University of Notre Dame

This paper examines the employment of craniometrics in bioarchaeology and forensic anthropology as an example of ways different epistemological understandings of evolutionary processes and theory change ways we can model the ways variation is constructed in human skulls. The standard evolutionary approach in craniometric studies encourages focus on biodistance, geographic origin, phenotypic proxies of genetic relatedness, and the influence of migration histories, social identity, and environment on these patterns. An approach to craniometric analyses involving the extended evolutionary synthesis (EES), in contrast, places additional emphasis on the interfaces of social and biological environments as they influence development, plasticity, and intra-/ inter-generational dynamics of epigenetic traits. Incorporating an EES approach into craniometrics expands the possible ways for interpreting the various patterns observed in cranial morphology. To date there are few published studies that use the EES framework within bioarchaeological and forensic work related to skull morphology. This can produce drastic differences in the use of methods, highlight alternative aspects of life histories, and thus modify the kinds of information and conclusions accessed by the researcher. For craniometrics, this paper suggests that based on research into plasticity from other areas of biology and biological anthropology, it may be possible to understand variation in the human skull as both a result of population ties and as a marker of developmental niche construction related to foodways and growth.

Stable Isotope Analysis of Childhood Diet at 1st Century B.C./A.D. Petra, Jordan

MALLORY PROVAN[1], MEGAN PERRY[1] and ROBERT H. TYKOT[2]

[1]Anthropology, East Carolina University, [2]Anthropology, University of South Florida

Investigations of diet and disease of the Nabataean capital city Petra have found that the adult residents suffered little from chronic infections or malnutrition and a diet consisting primarily of C_3 sources. However, little is known of childhood health and nutrition in the population since few remains of children have been recovered from excavated tombs. This study uses carbon and oxygen isotope ratios ($\delta^{13}C$ and $\delta^{18}O$) of dental enamel apatite in first molars (n=31), first premolars (n=20), and second molars (n=29) to explore childhood diet and weaning patterns in a 1st century B.C/A.D. sample from Petra. Dietary and trophic level changes, particularly those associated with weaning, should result in a decrease in mean $\delta^{18}O$ values and a shift toward the adult bone apatite $\delta^{13}C$ values across the M1, PM1, and M2 tooth classes.

In this case, the differences between tooth classes did not follow the expected pattern. A slight decrease in $\delta^{13}C$ mean values occurs between M1 (μ=-11.6) and PM1 (μ=-11.2) (Wilcoxon Z=3.3131, p=0.0017), followed by no difference in M2 values (μ=-11.3). All tooth classes differed from the adult bone value mean (μ=12.9) ($p<0.0001$ in each case). The $\delta^{18}O$ values show a similar pattern, with an initial decrease between PM1 and M1 means followed by an increase in M2 mean values. Thus, the expected shifts as children become less reliant on breastmilk and shift to solid foods do not appear in this sample. Immigrant children, with slightly divergent diets and water sources within the sample, could present a confounding factor.

Sensitivity analysis of semilandmark sliding method and evolutionary model choice in ancestral state reconstructions: The hominoid facial skeleton as a test case

ALEXANDER D. PRUCHA[1] and SERGIO ALMÉCIJA[1,2]

[1]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, [2]Institut Català de Paleontologia Miquel Crusafont (ICP), Universitat Autònoma de Barcelona

Three-dimensional geometric morphometric (3DGM) methods have become increasingly accessible and efficient tools for skeletal biologists, anatomists, and paleontologists

to characterize and analyze complex shape data. These methods allow the description of morphological diversity within a sample to incredibly high resolution. Furthermore, novel evolutionary modeling approaches are becoming increasingly used (often in combination with 3DGM) to study the mode and tempo of evolution, reconstruct possible ancestral morphologies, and test hypotheses for the pathways to extant and fossil anatomical trends. This study evaluates how critical decisions made along the different workflow steps (e.g., semilandmark sliding criterion, assumed evolutionary model) affect the results of analyses downstream.

We examined the facial anatomy of a primate cranial sample (n=25 species) representing extant anthropoid variation. Facial morphology was captured using 73 landmarks and 770 semilandmarks describing the anterior cranium extending posteriorly to the coronal suture, pterygomaxillary fissure, and free edge of the palate, and including the zygomatic arches. Sliding semilandmarks to minimize either Procrustes distances or bending energy produced effectively the same description of interspecific morphological diversity, as depicted by principal components analysis of the sample. However, maximum likelihood ancestral state reconstructions (ASR) for several clades were closer to the morphologies of their tip taxa under a multiple variance Brownian motion model than under standard Brownian motion. These results highlight the need to conduct ASR under multiple different methodological schemes for the same research question, before drawing conclusions about their results. This may prove especially important when using ASR to ascribe phylogenetic affinities to fossils.

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Variations in Gestural Communication Across and Within Captive and Wild Sub-Adult Western Lowland Gorillas (*Gorilla gorilla gorilla)*

MACKENZIE R. PRYOR[1], CAROLINE E. JONES[2], DOROTHY M. FRAGASZY[2], ROBERTA SALMI[3] and JOHN C. MAERZ[1]

[1]Warnell School of Forestry and Natural Resources, University of Georgia, [2]Department of Psychology, University of Georgia, [3]Department of Anthropology, University of Georgia

Nonhuman primates use vocal communication as a response to evolutionarily urgent events such as predator avoidance, group travel, or food discovery. Gestural communication, however, is used mainly in social contexts such as play, grooming, or agonistic encounters, and can show great variation. This project focused on the diversity in gestural communication in a zoo-housed population of juvenile (<7 years) western lowland gorillas (*Gorilla gorilla)* at Zoo Atlanta, GA, USA (n=5). An ethogram was constructed to record gesture frequencies from May to July 2017. In total, 120 hours of data were collected. As gestural communication is observed more frequently than vocal communication in captive populations, we hypothesized that a wide range of gestures would be used within the population, and that variability in the types of gestures used would be observed between individuals. Through preliminary data analysis, gestures "chest beat", "body slap", and "clap" were used a total of 106 times out of the 172 total gestures observed within the population. These gestures were used most often in concurrence with play behavior, yet 6 of these gestures were used to show aggression or ownership toward an object. Though each subject used the same gestural repertoire, there was variability in the frequencies in which the individuals used each gesture. Future analysis will include a comparison with wild data to observe ecological differences.

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A small-bodied catarrhine from the Miocene of India: additional evidence of an undersampled radiation

KELSEY D. PUGH[1,2], CHRISTOPHER C. GILBERT[1,2,3], BIREN A. PATEL[4,5], CHRISTOPHER J. CAMPISANO[6,7], NINGTHOUJAM P. SINGH[8], MICHELLE SINGLETON[9], JOHN FLEAGLE[10] and RAJEEV PATNAIK[8]

[1]PhD Program in Anthropology, The Graduate Center, CUNY, [2]New York Consortium in Evolutionary Primatology, (NYCEP), [3]Department of Anthropology, Hunter College, CUNY, [4]Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [5]Human and Evolutionary Biology Section, Department of Biological Sciences, University of Southern California, [6]School of Human Evolution and Social Change, Arizona State University, [7]Institute of Human Origins, Arizona State University, [8]Department of Geology, Panjab University, [9]Department of Anatomy, Chicago College of Osteopathic Medicine, Midwestern University, [10]Department of Anatomical Sciences, Stony Brook University

A lower third molar of a catarrine primate was recently recovered from Sunetar near Ramnagar, India. This tooth is distinct from the M_3s of other primates found in the area, including *Sivapithecus*, *Sivaladapis,* and *Ramadapis*, and morphological comparisons indicate that it differs from pliopithecoids in a number of phylogenetically informative features. The new M_3, which is similar in size to the same tooth in *Hylobates*, most closely resembles East African Miocene catarrhines commonly referred to as dendropithecoids. To further assess its affinities and the utility of M_3 characters in phylogenetic inference of catarrhines, we conducted two phylogenetic analyses using parsimony: one using only M_3 characters (31 characters scored for 35 taxa), and a second including a broad range of craniodental and postcranial features (262 characters for 49 taxa). Most parsimonious trees (MPTs) resulting from the M_3 only analysis consistently resolved several major groups, including pliopithecoids, crown hominoids, and hylobatids, though resolution in the consensus trees is otherwise poor. In this analysis, the new fossil is found to be sister to a clade composed of dendropithecoids and stem and crown hominoids. Consistent with the observation that additional data increases phylogenetic accuracy even when there are many missing data, the analysis with more characters and taxa recovers additional well-supported catarrhine clades and reconstructs the new M_3 as a stem hominoid in all MPTs. In either scenario, the implication of these results is that there is a previously unrecognized and/or undersampled radiation of catarrhines, probably stem hominoids, in South Asia during the Miocene.

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The Evolution of Human Sex Differences

DAVID PUTS

Anthropology, Penn State

In humans, as in other mammals, testicular androgens masculinize and defeminize morphology and behavior and are thus critical to sexual differentiation. However, several factors may be jointly responsible for the evolution and maintenance of human sexual dimorphisms, including phylogenetic inertia, sexual division of labor, and sexual selection operating on women and men. Here, I review and synthesize evidence suggesting that the salience of these factors likely differs across traits. For example, phylogenetic inertia is at least partly responsible for sex differences in physical aggression, facial robusticity, body size, and muscularity, and selection for hunting ability may have continued to favor size and strength in men. By contrast, sexual selection may be responsible for body fat distribution in women and deep voices and facial hair in men. Overall, women's phenotypes appear to have been shaped more strongly by intersexual selection, and men's phenotypes appear to have been shaped more strongly by intrasexual selection.

The role of working memory while learning prehistoric stone toolmaking skills: A functional brain imaging study

SHELBY S. PUTT[1], SOBANAWARTINY WIJEAKUMAR[2] and JOHN P. SPENCER[2]

[1]Center for Research into the Anthropological Foundations of Technology, The Stone Age Institute, [2]School of Psychology, University of East Anglia

The enhanced working memory hypothesis proposes that modern cognition evolved when a recent genetic mutation led to enhanced working memory capabilities in *Homo sapiens*. According to this model, stone tool artifacts produced prior to this event would have required procedural memory and not working memory. Because both human and nonhuman primates have been shown to recruit working memory brain areas during the early stages of learning a new motor task, we predicted that stone toolmaking should also recruit a working memory network when first being learned. Over the course of a 7-hour-long training program, we used image-based functional near-infrared spectroscopy to record the functional brain activity of 33 right-handed, adult, human participants at three different points as they learned to make replicative Oldowan and Acheulian stone tools. The optic signals from the two knapping tasks were processed to produce functional images of the brain that were analyzed using a multifactorial ANOVA. The knapping tasks were then compared to a motor baseline task with Wilcoxon signed-rank tests to exclude any general motor areas that are involved in stone knapping. Results revealed that only the Acheulian technology recruits the left dorsolateral prefrontal cortex, an area critical to working memory function. We conclude that working memory was the most likely cognitive strategy that pre-sapiens *Homo* utilized when learning to make Acheulian and other complex tools. We should therefore consider that "modern" cognition emerged in a piecemeal fashion over the course of human evolution rather than suddenly occurring with the appearance of *H. sapiens*.

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Characterizing the regulatory landscape of human skeletal muscle tissue

SAMANTHA R. QUEENO[1], MATTHEW C. O'NEILL[2], DANIEL RICHARD[3], TERENCE D. CAPELLINI[3,4] and KIRSTIN N. STERNER[1]

[1]Anthropology, University of Oregon, [2]Basic Medical Sciences, University of Arizona College of Medicine, [3]Human Evolutionary Biology, Harvard University, [4]Broad Institute, MIT and Harvard

Recent research suggests that selection for more efficient bipedal locomotion has decreased relative fiber length and increased the expression of MHC I in human skeletal muscle over the past 7-8 million years. These traits differentiate humans from many other primates, including African apes. However, to better understand the tempo and mode of skeletal muscle trait evolution in hominins a genomic approach is required. Here, we begin by characterizing the regulatory landscape of human skeletal muscle tissue to define genomic regions that shape limb muscle development. To do this we first analyzed human epigenomic data for fetal and adult skeletal muscle tissues available from the Roadmap Epigenomics Project. For all pre- and post-natal stages, we used peak calling algorithms and bedtools to identify thousands of regulatory regions (e.g. DNase I HS or H3K27ac modifications) that are conserved across biological replicates for a specific time-point and tissue. We then were able to identify regulatory sequences unique to fetal or adult muscle function, and specific to individual anatomical regions (i.e., fetal arm versus fetal leg). We next curated genotype-phenotype data from Mouse Genome Informatics and the Online Mendelian Inheritance in Man to identify loci involved in muscle development and function. For example, we found more than 50 genes involved in skeletal muscle fiber type. We identified a number of relevant loci, which display evidence of differential regulatory activity in fetal versus adult time-points as well as different anatomical regions. These constitute loci of potential importance to the evolution of human muscle function.

As the Sun Sets, We Remain: Oseteobiographies from the Gause Cemetery at Seaside

JORGE R. QUINTANA, MEGAN PERRY and CHARLES EWEN

Anthropology, East Carolina University

In 2014, *USA Today* reported that the search for family roots was the second most popular hobby in the U.S.. The concomittant recognition by the general public of the forensic and bioarchaeological value of human skeletal remains has, in a few cases, proffered osteological analysis as another form of genealogical research. This study focuses on the excavation of a small cemetery of a politically and economically prominent family in Sunset Beach, NC, likely dating to the late 18th to early 19th centuries A.D., at the request of a descendant. The osteobiographical approach utilized here provides a detailed, contextualized study of the physical remains to complement other historical data on the family. Three brick burial vaults were excavated in 2017, recovering the skeletal remains of three potential adult ancestors of the descendant. The young adult female (20-34 years old) and two adult males (35-39 years old and 40-49 years old) have paleopathology profiles expected of free landowners in the antebellum Southestern US based on comparative samples, with almost no lesions indicative of infectious diseases and malnutrition but with poor dental health. In addition, the young adult female was subjected to a unique form of perimortem surgical or autopsy procedure not seen in other contemporary remains, providing insight into medical treatment in rural antebellum North Carolina. The detailed osteobiographies presented in this study reflect the benefits and limitations of these data for genealogical research and addresses the ethical issues tied to descendant-initiated excavation of cemeteries.

Osteoarthritis of the cervical vertebrae, C3-C7, from an identified skeletal collection

BREIDY IVAN. QUISPE and FRANK L'ENGLE WILLIAMS

Anthropology, georgia state university

Osteoarthritis of the cervical vertebrae, C3-C7 is affected by age, life style, diet, genetics and long-term or extreme skeletomuscular strain. However, the extent to which older adults differ from the elderly and the degree to which sex differences influence the expression of osteoarthritis is difficult to evaluate due to variation in the biological aging process and the absence of post-reproductive age distinctions. We report on the scores of a ranked system from the Chicago Standards to assess osteophytic lipping, porosity and eburnation on the cervical vertebrae of identified individuals from the William M. Bass Donated Skeletal Collection of the Forensic Anthropology Center, University of Tennessee, Knoxville. We address whether the expression of osteoarthritic features differs (1) between older adults, 50-55 years, and elderly individuals, 70-76 years, within each sex; (2) between both sexes of the same age category; and (3) between the sexes regardless of age. The sample reflects contemporary variation as all individuals were accessioned from 2000 to 2010. The atlas and axis were excluded because they differ from C3-C7 in morphology and function. The vertebrae were separated by number and analyzed using nonparametric tests. Osteoarthritic lipping is more extreme in males when compared to females. However, older females (50-55 years) exhibit greater eburnation than their elderly counterparts (70-76 years). Both females and males present an increase of osteoarthritic features as a result of advancing age. However, sex differences between elderly (70-76 years) adults are less extreme compared to when all females and males are considered regardless of age.

Evolutionary implications of limited evidence of frailty in mammals

KARYNE N. RABEY[1], PIERRE LEMELIN[1], ROSHNA E. WUNDERLICH[2], MEGAN SNYDER[3] and DANIEL SCHMITT[3]

[1]Department of Surgery, Division of Anatomy, University of Alberta, [2]Department of Biology, James Madison University, [3]Evolutionary Anthropology, Duke University

Frailty, which is observed clinically in humans, is the inability to carry out activities of daily living. Gait frailty is evidenced by slower walking speed, changes in limb loading, and reduced movement fluidity, all of which could lead to injury

and predation in non-human animals in the wild unless they develop compensatory gait strategies. Therefore, we hypothesize that animals will experience less reduction in locomotor capacity as they age than is observed in humans; animals will experience senescence but limited loss in locomotor performance. These data explore the possibility that frailty is an evolved characteristic of modern humans, where a community exists to support frail individuals. As a first step, we tested this hypothesis in a detailed gait analysis using adult (n = 10; age = 4 months) and aged (n = 20; age = 24 months) mice. We observed no significant changes in body mass or locomotor mechanics: similar peak vertical forces in fore- and hindlimbs (e.g., forelimbs: adult = 0.20N ± 0.04; aged 0.21N ± 0.06), loading rates, and velocity (adult = 0.85m/s ± 0.22; aged = 0.77m/s ± 0.18). All mice moved fast, fluidly, and competently despite their age. In a number of our past and ongoing studies in strepsirrhines, we found that gait speed, limb angles, and leap height were unchanged across a wide age range. The lack of clear evidence for frailty in mice and possibly in some primate species suggests that frailty may be found primarily in humans, an idea that needs further investigation.

Allomaternal care by conspecifics changes activity budgets of *Colobus guereza* mothers

DOMINIQUE L. RABOIN[1], ANDREA L. BADEN[2,3] and JESSICA M. ROTHMAN[2,3]

[1]Psychology, Hunter College of the City University of New York, [2]Anthropology, Hunter College of the City University of New York, [3]New York Consortium in Evolutionary Primatology

Primate infant care involves lactation, protection, provisioning, and carrying, which are all energetically taxing states for mothers. In some primates, allomaternal care (AMC), care of offspring by conspecifics, may alleviate this burden and allow lactating mothers the opportunity to feed and rest without their clinging infants. The objective of this study was to document the nature of AMC in *Colobus guereza* and to determine the potential feeding benefits for lactating mothers during AMC. In Kibale National Park, Uganda, mother-infant dyads in three groups of *Colobus guereza* were observed. Preliminary data suggest during AMC bouts, mothers fed ~35% of the time and rested ~51% of the time (SD=32.6). Mothers used the remaining time without their infants to groom or travel. The mean length of an AMC bout was 28 sec. Males handled infants during 25% of AMC bouts (SD=29). Adults handled infants ~56% of the time and juveniles/subadults handled infants ~44% of the time (SD=11). Sex and age of the helper did not have an effect on the duration of the infant handle bout (Mann-Whitney U, p>.05). Lactating mothers fed and rested more when their infant was being handled by a conspecific than when they were caring for their infant (X^2=6.63, df=1, p=0.01). These results provide evidence that AMC in this species gives lactating mothers the opportunity to replenish energy through resting and feeding without clinging infants.

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Dental and long bone growth in four juvenile individuals from Mesolithic layers of Vela Spila Cave, Korčula, Croatia

DAVORKA RADOVČIĆ[1], ZACHARY COFRAN[2] and DINKO RADIĆ[3]

[1]Department of Geology and Paleontology, Croatian Natural History Museum, [2]Anthropology Department, Vassar College, [3]Archaeological Collection, Vela Luka Culture Centre

Juvenile remains from the Mesolithic period are relatively scarce, creating a black box in our understanding of growth and health during this transitional time period. Here, we report on human remains from Vela Spila Cave in Croatia that provide a rare glimpse into life at this time. Four infant skeletons were excavated from three graves during excavations in 1986-1988. One of the skeletons was directly dated to c. 9000 years B.P., and the remaining three were found in the same layer (layer 7/2) and in close proximity (about 50 cm distance) to the directly dated skeleton, and so presumably date to the same time. Using published standards of skeletal and dental maturation, we estimate the age at death of these individuals. Grave 1 consists of the leg bones of a 7-9 month old fetus, as well as a more complete skeleton of an infant aged 2.5-3.5 years. Grave 2 contains the remains of an infant aged 2.5-3 years, and Grave 3 contains the skeleton of a 1-6 month old infant. Considered together, these infants do not deviate from recent human growth patterns. The presence of only young infants, lacking perimortem skeletal trauma or skeletal indicators of stress, at Vela Spila raises interesting questions as to the nature of these burials.

Maxillary sinuses do not accommodate nasal cavity size in strepsirhines

TODD C. RAE[1] and THOMAS KOPPE[2]

[1]CRESIDA, Life Sciences, University of Roehampton, [2]Institut für Anatomie und Zellbiologie, Ernst-Moritz-Arndt-Universität Greifswald

The biological role of the paranasal sinuses of vertebrates remains unclear at present, despite recent attempts to clarify the relationship of craniofacial pneumatization to functional/ontogenetic aspects of the facial skeleton. One suggested function is that sinuses may act as an accommodating mechanism for growth in other modules of the facial skeleton. This is most often mooted as an explanation of the variation in the maxillary sinuses, which occupy the body of the maxilla lateral of the nasal cavity; for a given volume of the facial skeleton, maxillary sinus volume would be expected to be negatively correlated with nasal cavity volume. Recent work on *Homo sapiens*, however, shows mixed results, at least some of which may be due to climatic factors, but also may result from the unique craniofacial configuration seen in our species.

To test the accommodation hypothesis using a broader comparative approach, adult, wild shot crania of several genera of strepsirhine primates (lemuroids and lorisoids) were imaged using pQCT and the resulting scans measured using SurfDriver. Summed left and right maxillary sinus volumes and nasal cavity volumes were subjected to partial correlation analysis, keeping facial volume constant. Results show the expected negative correlation between the two variables, but not one that is statistically significant. Thus, there is no unequivocal support for the contention that pneumatic cavities act to accommodate the size of the nasal capsule for a given size of the face.

Paleogenomic investigations of the ancient inhabitants of the Lower Pecos region of Texas and Northern Mexico

JENNIFER A. RAFF[1], AUSTIN W. REYNOLDS[2,3], SOLVEIG TURPIN[4], NADIN ROHLAND[5], DAVID REICH[5,6,7] and DEBORAH A. BOLNICK[3,8]

[1]Department of Anthropology, University of Kansas, [2]Department of Integrative Biology, University of Texas at Austin, [3]Department of Anthropology, University of Texas at Austin, [4]., University of Texas at Austin, [5]Department of Genetics, Harvard Medical School, [6]Broad Institute, Harvard and MIT, [7]Howard Hughes Medical Institute, [8]Population Research Center, University of Texas at Austin

Genomic analyses of ancient and contemporary indigenous peoples in the Americas have yielded new insights about the initial peopling of the Americas as well as early patterns of population differentiation across the American continents. However, this focus has left gaps in our understanding of the subsequent genetic evolution of Native American communities in diverse regions of the continents. Because studies of genomic variation in the continental United States have been less common, we know little about the specific patterns of variation in both ancient and present-day populations in this region. One area that is especially depauperate of genetic data is central Texas and northern Mexico. The Lower Pecos Canyonlands in this region are ideal for investigating these questions because of their location and 13,000-year history of occupation.

To better understand the genetic diversity and population history of this region, we analyzed ancient DNA from individuals buried at several Lower Pecos sites and the Cueva de la Zona site in Northern Mexico. We successfully sequenced

the first hypervariable region of the mitochondrial DNA of 18 individuals. For samples with well preserved DNA, we sequenced complete mitogenomes and targeted approximately 1240k genomewide SNPs for capture and Illumina sequencing. Genomic comparisons with contemporary populations and ancient individuals indicate that the ancient Lower Pecos inhabitants are most closely related to present-day indigenous populations in Mexico, with affinities to contemporary South Americans as well. We discuss the implications of this research for understanding the population history of the Lower Pecos and North America more broadly.

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Chimpanzee (*Pan troglodytes*) and gorilla (*Gorilla gorilla*) manual trabecular architecture over ontogeny

ANNA J. RAGNI

Vertebrate Paleontology, Richard Gilder Graduate School, American Museum of Natural History, New York Consortium in Evolutionary Primatology

Chimpanzees (*Pan troglodytes*) and gorillas (*Gorilla gorilla*) have been argued to have independent origins of knuckle-walking behavior based on biomechanical and ontogenetic differences within the hand. This study presents an internal approach to better understand the ontogeny of knuckle-walking in these taxa. Trabecular bone has been shown to respond to changes in loading, making it functionally informative of behavioral changes. *Pan* and *Gorilla* share behavioral changes over ontogeny, such as decreasing overall activity levels into adulthood, but also differ in the ontogenetic development of bony traits potentially related to knuckle-walking, and have unique hand postures during locomotion in adulthood. Focusing on a region of interest within the head of the capitate, this project assesses trabecular differences over ontogeny in six dentally-defined age categories for both *Pan* and *Gorilla*.

Capitate bones were µCT scanned at 30-40 µm resolution with volumes of interest (scaled to 50 percent of the maximum mediolateral breadth of each bone) placed centrally within the head of the capitate for analysis. Ontogenetic trends were assessed for each taxon as well as between taxa using a standard series of trabecular morphometrics. Results showed significant changes over ontogeny in Bone volume fraction, Bone surface density, and Trabecular number for both taxa (p<0.05), mirroring documented behavioral changes over ontogeny. Contrary to expectations, however, no ontogenetic trends were significantly different between *Pan* and *Gorilla*. These findings warrant further research into the knuckle-walking anatomical complex as well as the locomotor differences between these taxa.

The effects of Spanish colonization on population structure in two regions of Mexico

COREY S. RAGSDALE[1], HEATHER JH. EDGAR[2] and CATHY M. WILLERMET[3]

[1]Department of Anthropology, Southern Illinois University Edwardsville, [2]Department of Anthropology, University of New Mexico, [3]Department of Sociology, Anthropology, and Social Work, Central Michigan University

Prior to Spanish contact in 1519, there were several different ethnic groups existing around Mexico, contributing to a complex socio-economic network. The Spanish conquest and colonization of Mexico in the 16th century led to drastic demographic changes for local populations throughout the colony of New Spain, and indigenous groups were lumped into a single category called "*Indio*". Little is known about the effects of Spanish and African admixture on population structures during the colonial period (1521-1821) in Mexico, or how indigenous variation from pre-contact groups is represented in the colonial population. We use biological distance analyses to investigate these phenomena in the Valley of Mexico (Mexico City) and Yucatan Peninsula, two regions that experienced different colonization strategies. Our results suggest that Spanish and African admixture patterns during the colonial period differed between the two regions, with more Spanish and African migrants represented in Mexico City. Our results show that Spanish and African admixture patterns differed in Mexico City based on location, specifically proximity to the center of the city or *Zócalo*. Finally, our results show that the colonial samples from Mexico City are biologically similar to the Aztec Mexica samples from Tlatelolco and Tenochtitlán. In the Yucatan, the historic sample is similar to all pre-contact samples compared. These preliminary findings represent the first of many analyses that will contribute to a better understanding of the biological effects of Spanish colonization on population structures throughout the colony of New Spain.

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Effects of posture and knee joint range of motion on subchondral and trabecular bone properties

MUNSUR RAHMAN[1,2], MICHELLE FARLEY[1], BRYCE D. CONRAD[1], MARIANA E. KERSH[2] and JOHN D. POLK[1]

[1]Department of Anthropology, University of Illinois at Urbana-Champaign, [2]Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign

Subchondral and trabecular bone comprise the ends of long bones and underlie articular surfaces that are known to respond different patterns of loading by increasing apparent density or aligning to trabecular orientation to the direction of applied loads. There is broad interest in applying analyses of subchondral and trabecular structure to the interpretation of behavior in extant and fossil primates including hominins. The goal of this project is to examine how experimentally induced differences in exercise and joint postures affect trabecular and/or subchondral bone properties such as local stiffness, strength, and load transmission through the whole epiphysis. We included 15 lambs (mean age=60d) for this study containing 5 individuals of each group: (i) incline treadmill exercise (15% grade), (ii) flat treadmill exercise, and (iii) non-exercise controls. Groups (i) and (ii) were exercised twice daily at 2.5m/s for 20 min/bout. Kinematic data were obtained using Qualisys motion capture system and ground reaction forces were obtained for incline and flat locomotion for all individuals. All right hind femora were microCT scanned at 50µm resolution. Kinematic analysis of knee joint angle showed that the incline group used more flexed knee postures at midstance than exercise or control groups. These differences were reflected in subchondral and distal trabecular properties as well which suggest that exercise induced changes in posture produced bony correlates in subchondral and trabecular bone. The results of this study provide additional experimental support for making functional inferences about joint loading conditions and movement patterns used by extinct hominins and other primates.

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Fractal patterns of physical activity in hunter-gatherers suggest universal scaling of daily movement in humans

DAVID A. RAICHLEN[1], MARC T. HAMILTON[2], JACOB A. HARRIS[3], CHIU-HSIEH HSU[4], SARAH K. KEADLE[5], YANN C. KLIMENTIDIS[4], TYLER J. MARX[1], CHARLES E. MATTHEWS[6], HERMAN PONTZER[7], M. KATHERINE SAYRE[1], BRIAN M. WOOD[8], THEODORE W. ZDERIC[2] and GENE E. ALEXANDER[10,11,12,13,14,9]

[1]Anthropology, University of Arizona, [2]Texas Obesity Research Center, University of Houston, [3]Institute of Human Origins and School of Human Evolution and Social Change, Arizona State University, [4]Department of Epidemiology and Biostatistics, University of Arizona, [5]Department of Kinesiology, California Polytechnic State University, San Luis Obispo, [6]Division of Cancer Epidemiology and Genetics, Metabolic Epidemiology Branch, National Cancer Institute, [7]Department of Anthropology, Hunter College, [8]Department of Anthropology, University of California, Los Angeles, [9]Departments of Psychology and Psychiatry, University of Arizona, [10]Evelyn F. McKnight Brain Institute, University of Arizona, [11]Neuroscience Graduate Interdisciplinary Program, University of Arizona, [12]Physiological

Sciences Graduate Interdisciplinary Program, University of Arizona, [13]BIO5 Institute, University of Arizona, [14]Arizona Alzheimer's Consortium

Fluctuations in daily physical activity (when we rest and when we are active) vary across the day in ways that seem random. However, recent work using wearable accelerometers has shown that, in industrialized societies, these patterns often have an underlying logic that resemble fractal patterns where fluctuations measured across short time-scales (minutes) are similar to fluctuations measured over longer time-scales (hours), a property termed self-affinity. Breakdowns in these patterns are associated with age, morbidity, and mortality in industrialized societies, suggesting this activity biomarker may reflect underlying physiology. Here, we examine fractal activity patterns in a sample of hunter-gatherers, the Hadza of Tanzania (n=42;age=13-72), to determine whether these patterns exist across vastly different lifestyles. We used the Detrended Fluctuation Analysis to measure signal self-affinity (scaling exponent of activity fluctuations vs. time-scales [α]~1.0) in time-series data derived from wearable accelerometers. Hadza participants had highly fractal, self-affine patterns of daily activity (α=1.06±0.05) which do not differ significantly across sex or age ($F[6,34]=0.89, p=0.51$) and are slightly, but significantly more self-affine than a large US population ($F[7,11694]=168.5, p<0.0001$). However, it is striking that despite great differences in how individuals spend their days, fractal activity patterns are present and similar in both populations. Our data suggest that fractal scaling of physical activity may be a human universal and that future investigations should focus on the evolutionary origins of this physiological biomarker. Understanding activity complexity in humans may lead to a novel evolutionary-based approach to monitoring health and well-being across human societies using wearable devices.

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The role of DNH 7, a female *A. robustus* skull, in illuminating the evolutionary history of the robust australopiths

YOEL RAK[1,2], WILLIAM H. KIMBEL[2,3], COLIN MENTER[4] and CHARLES A. LOCKWOOD[2]

[1]Anatomy and Anthropology, Sackler Faculty of Medicine, Tel Aviv University, [2]Institute of Human Origins, Arizona State University, [3]School of Human Evolution and Social Change, Arizona State University, [4]Centre for Anthropological Research (CfAR), University of Johannesburg

In the reconstruction of australopith evolution, much can be inferred from the morphocline of the masticatory system. This morphocline becomes more specialized over time, culminating in the masticatory system of *Australopithecus boisei*. Because much of the specialization is achieved through the extension of the facial bones (carrying the masticatory muscles forward) and the retraction of the dental arcade (transforming the mandible into a more efficient lever), these shifts have a great effect on the morphology of the facial mask, which becomes highly modified, beginning with the generalized face of *A. afarensis* and continuing to the elaborately specialized face of *A. boisei*.

A morphological gap in this sequence was seen to occur between *A. africanus* and *A. robustus*. This gap stemmed from the rarity of well-preserved *A. robustus* female skulls, which tend to display relatively generalized morphology on australopith species' morphoclines, but is now bridged by the female skull DNH 7, from the 2.0-1.6 Ma Drimolen site, in South Africa. Not only is this specimen evidently a female, but it is also one of the most complete skulls in the *A. robustus* hypodigm. The masticatory system metrics of DNH 7 reduce the gap between the anatomy of *A. africanus* males and that of *A. robustus* males. Not surprisingly, since the morphology and metrics are closely related, the details of DNH 7 facial topography represent intermediate character states that have been missing until now.

We thank the Institute of Human Origins at Arizona State University and Tel Aviv University for supporting this project. Charles Lockwood's posthumous authorship recognizes his foundational contributions to this research.

The challenges of forensic geolocation in the context of water insecurity in Mexico: Understanding the relationships and limitations between isotopes in drinking water, teeth and hair

ROBIN RAMEY and CHELSEY A. JUAREZ

Anthropology, NC State

The relationship between oxygen and hydrogen isotopes in drinking water, hair, and teeth have been successfully modeled in the United States, Europe and Asia to track migration and provenance for humans. Provenance studies using water isotopes rely on the collection of known sources for drinking water. Large portions of Mexico face intermittent or permanent water insecurity and Mexico leads the world in bottle water use complicating isotope modeling for provenance studies.

This study explores the relationships between tap/bottle water and tooth and hair samples of known Mexican origin. A subset of samples were used for this study including $\delta^{18}O$ from N=64 human teeth, $\delta^{18}O$ and $\delta^{2}H$ for N= 30 hair samples and $\delta^{18}O$ and $\delta^{2}H$ for N= 75 water samples from overlapping regions in Central and Southern Mexico. Water values spanned a range from -12.7 ‰ to +0.4 ‰ and -91.7‰ to -4.2 ‰ for $\delta^{18}O$ and $\delta^{2}H$, respectively. Estimated drinking water generated from tooth enamel was $\delta^{18}O$ -4.8‰ to -11.3‰. A one-way ANOVA demonstrated that means for measured and estimated drinking water were statistically significantly different between regions $F(7,104)=7.817$, ($P<0.05$), but demonstrated large overlap between regions. Linear regressions produced the following relationships between hair and water samples, $\delta^{2}H_h = -51.678+0.347 * \delta^{2}H_w$ $R^2=0.65$; $\delta^{18}O_h = 16.256.+0.342 * \delta^{18}O_w$ $R^2=0.32$. These correlations are far lower than those published for other regions. The inconsistent results between enamel and hair suggests shifting water usage over time and multiple water inputs in the diet.

Manual joint size contributes to flexor muscle performance in suspensory taxa

KRISTEN R. RAMIREZ[1,2] and THOMAS C. PRANG[2,3]

[1]Anthropology, CUNY Graduate Center, [2]NYCEP, New York Consortium in Evolutionary Anthropology, [3]Center for the Study of Human Origins (CSHO), Department of Anthropology, New York University

Identification of suspensory behaviors in fossil primates has previously been restricted to the curvature and relative length of metacarpals and phalanges. However, there is morphometric overlap among taxa characterized by varying frequencies of suspension. With increased functional and biomechanical studies, we aim to identify additional features useful in discerning suspensory behavior from skeletal remains. Previous experimentation shows that manual flexors are recruited more for support in suspension than in stability during arboreal or terrestrial quadrupedalism. The amount the flexors need to contract during grasping is proportional to the arc length traveled by a phalanx palmarly over the convex surface of the corresponding proximal joint. Reduced magnitude of contraction maintains the flexor muscles at or near peak force per the muscular length-tension curve. This means that joint size may be related to grip strength across the range of flexion during grasping. Here, we test the hypothesis that dorso-palmar reduction in metacarpals and phalanges is associated with suspensory capability. We collected standard linear measurements on the metacarpals and proximal and distal phalanges in a large sample of 23 anthropoid genera (n=275). Suspensory hylobatids and *Pongo* dorsopalmarly reduced metacarpal heads and phalangeal trochleae in accordance with biomechanical predictions. These results support the hypothesis that metacarpal and phalangeal articular proportions reflect locomotion, and suggest the utility of individual element shape to identify suspensory behaviors in extinct taxa.

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Estimating stature and sex from incomplete postcranial remains in a late Medieval Prussian population at Bezławki, Poland

MARISSA RAMSIER[1], ARIEL GRUENTHAL-RANKIN[1,2], ARKADIUSZ KOPERKIEWICZ[3] and MAREK POLCYN[4]

[1]Anthropology, Humboldt State University, [2]Anthropology, Binghamton University (SUNY), [3]Institute of Archaeology, University of Gdansk, [4]Anthropology, Lakehead University

This study examined skeletal remains of n=60 older subadult to adult individuals from a Late Medieval (XIV-XI c.) Prussian cemetery at Bezławki, Poland, to explore the relative efficacy of using isolated postcranial elements for estimating stature and sex. Within the sample, sex was initially estimated based on traditional qualitative characteristics of the cranium, mandible, and pelvis (n=23 likely female, n=26 likely male, n=11 intermediate/indeterminate). Of the sample, remains for n=22 individuals (n=13 likely female, n=9 likely male) were complete enough to enable stature calculation via the Fully (anatomical) method, resulting in an estimated average female stature of ca. 156 cm (S.D. 5.5, range 148-166 cm), and an average male stature of ca. 172 cm (S.D. 9.9, range 158-186 cm). All long bones of the limbs strongly predicted stature as determined via the Fully method (P<0.001, R2: 0.85-0.95), with the most linear relationship evinced by bicondylar femoral length. Within a larger sample of n=54 individuals, maximum femoral head diameter consistently separated likely females (3.8-4.5 cm) from likely males (4.6-5.6 cm); there was a general pattern of separation based on long bone length, but there was more overlap. Average female and male stature, femoral bicondylar length, and the relative contribution of the femur to overall stature very closely corresponded with data reported for the nearby (ca. >400 km) roughly contemporaneous (XI-XII c.) site at Giecz, Poland, suggesting that at least for this region and time period, some criteria established based on one population may be applicable to others.

The Didactic Media in Teaching Human Evolution at Anthropological Museum Montané of the University of Havana (1962-2017)

ARMANDO RANGEL RIVERO, MIGUEL ÁNGEL GARCÍA PIÑERO and CARLOS ARREDONDO ANTÚNEZ

Anthropological Museum Montané, University of Havana

The Anthropological Museum Montané of the University of Havana was founded in 1903. In 1962 it took places a reform of education at the university. Since then its functions have been research, outreach initiative and teaching related to Physical Anthropology. The goal of the paper is to demonstrate the importance of the didactic media that been used in teaching of human evolution. The collection of slides in glass support has been reviewed, and 80 pieces related to various biological and cultural aspects of the hominization were selected. These photographic supports studied appeared from the beginning of the 20th century until the 60s and are an example of the international dissemination reached by these slides. Currently the museum has an area of its exhibition room dedicated to human evolution, in which students and the general public can observe more than 20 replicas from cranium from Australopithecus to Homo sapiens, such as reproductions of the Child of Taung and the fraud of the Man of Piltdown. In addition they are exhibited a piece of Olduvai, objects of the Upper Paleolithic, and two maps explaining the migrations outside Africa and the arrival of the first settlers in America. The pieces have been donated by institutions in France, Mexico and the United States of America. The research is based on the multidisciplinary analysis, since it includes scientific, cultural heritage and historical values of the didactic means used in the teaching of human evolution

To be or not to be (a daddy): relationship between concealed ovulation and paternity certainty in black and gold howler monkeys in Northern Argentina

MARIANA RAÑO[1], LUCIANA I. OKLANDER[2], CLAUDIA R. VALEGGIA[3], SOL GENNUSO[1], BELEN NATALINI[1], VERONICA L. ROMERO[1] and MARTIN M. KOWALEWSKI[1]

[1]Estación Biol. Corrientes-MACN BR, CONICET, Argentina, [2]Instituto de Biología Subtropical (IBS), CONICET-UNAM, Argentina, [3]Department of Anthropology, Ecology Laboratory, Yale University

It has been postulated that female non-human primates implement different strategies for confusing paternity including mating with several males, copulations outside the fertile period, dispersion, and coalitions across their ovulatory cycle. We explored whether males with whom the female copulated during the POP (periovulatory period) were the father of their offspring as well. We combined behavioral, hormonal and genetic studies of wild black and gold female howlers (*Alouatta caraya*), inhabiting the San Cayetano State Park (27° 30' S-58° 41' W) in northern Argentina. We collected 3850 hours of mating behavior and 877 urinary samples from 5 females in two different groups from August 2011-August 2012. We also run genetic studies to estimate paternity of infants born during the study period trough microsatellite analysis of fecal samples (N = 16). Paternity analyses revealed that central males were the most likely progenitors of infants born during the study period in half of the cases. When matching these results with the ovarian hormone profiles, there are coincidences in all but one of them, where their profile reveals that copulations occurred during the POP were with the central male, but the paternity corresponds to the non-central male. This indicates that, in general, *A. caraya* females effectively implement a mixed strategy, switching mating strategies across the ovulatory cycle.

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Associations between humeral head curvature and habitat use in cercopithecids

ANDREW J. RAPOFF[1], ERIN E. KANE[2], NOAH DUNHAM[3], DAVID J. DAEGLING[4] and SCOTT MCGRAW[5]

[1]Mechanical Engineering, Union College, [2]Anthropology, Boston University, [3]Anatomy and Neurobiology, Northeast Ohio Medical University, [4]Anthropology, University of Florida, [5]Anthropology, Ohio State University

Primate limb morphology reflects locomotor tendencies and patterns of habitat use. For example, humeral head curvature is known to covary with locomotion and gross substrate preferences among extant taxa and used to infer terrestriality in several Miocene catarrhines. Curvature has traditionally been determined using two locations along a profile and a circular fit, although it varies along the profile and depends on the profile plane. Herein, we demonstrate a repeatable method for determining the varying profile curvature in a reproducible plane of interest.

We obtained surface coordinates using a laser scanner on humeri from 7 cercopithecoid taxa whose positional behavior is known. Curvatures of the head along a mediolateral profile were determined using the calculus formula and a numerical technique that simultaneously minimizes the sum of the differences between the coordinate data and curve fit function and the numerical derivatives of the data and function derivatives. To compare humeri of varying size, curvatures for each specimen were scaled by the maximum value for each specimen, while positions along each profile were scaled from 0 to 1.

We found that for all specimens, the medial aspect was between 5 to 2 times flatter than the lateral aspect. We found a complex relationship between flatness, sex and arboreality. Generally, taxa that spend some time on the ground have humeral heads that are flatter laterally, more so for males than females. Refining relationships between humeral head shape and habitat use in extant taxa strengthens our ability to reconstruct behavior in fossil taxa.

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Functional genetic variation among rhesus macaques (*Macaca mulatta*): A newly recognized and powerful tool for research

MUTHUSWAMY RAVEENDRAN, R. HARRIS and JEFFREY ROGERS

Human Genome Sequencing Center, Baylor College of Medicine

Rhesus macaques, including the unique and valuable population on Cayo Santiago, have made many important contributions to basic primate research and to biomedical studies relevant to health and disease. Knowledge of the genetic basis of individual phenotypic variation is central to understanding basic and applied primate biology. We have used the Illumina Hi-Seq 2000 and Hi-Seq X platforms to generate whole genome sequence data for more than 500 rhesus macaques, including 35 animals from Cayo Santiago. These sequence data have revealed >72.7 million single nucleotide polymorphisms (SNPs) among the >500 rhesus macaques. We find that rhesus exhibit an average of 9.48 million SNPs per individual, more than 2-fold higher than humans, and also carry a substantial number of small insertion-deletion variants. Many of these variants are predicted to affect protein sequences, and thus may have functional consequences for phenotype. We identified >304,000 unique missense variants, altering 19,924 macaque protein coding genes, 94.4% of the annotated genes in that genome. Our growing dataset of potentially functional variation includes genes known to influence neurobiology and behavior, heart disease, cancer, retinal diseases and vision, and various other medically significant phenotypes. This presentation will summarize these data concerning genetic variation in the Cayo Santiago macaques and other captive rhesus macaque populations. We will discuss the impact of this information on our understanding of normal genetic and phenotypic variation in rhesus, as well as the development of new primate models of disease.

Inside Out: Intrinsic Determinants of Morphological Variation in the Developing Skeleton

MATTHEW J. RAVOSA[1,2,3], SUSAN COINER-COLLIER[1], NATHAN E. HOLTON[4], ERIN M. FRANKS[5], ALISON M. LEMKUIL[1] and ELIZABETH B. MCGOUGH[1]

[1]Department of Biological Sciences, University of Notre Dame, [2]Department of Aerospace and Mechanical Engineering, University of Notre Dame, [3]Department of Anthropology, University of Notre Dame, [4]Departments of Orthodonctics and Anthropology, University of Iowa College of Dentistry, [5]Department of Anatomy and Neurobiology, NEOMED

Traditional *and* modern comparative approaches typically view bone as a hard tissue that varies little across the skeleton, and among species, in its ultrastructure, mechanical properties and plasticity responses. In this paradigm, morphological and functional variation at homologous sites is due largely to differences in extrinsic ecological and behavioral factors that affect the magnitude, frequency, duration and rate of loading patterns underlying bone formation. While undoubtedly there is a genetic component to variation in primate skeletal form due to natural selection and evolution, arguably there is an underappreciation of intrinsic determinants of osteogenesis that modulate phenotype responses across the skeleton within individuals and across populations. Although some of these latter suite of factors are known to be heritable, they all significantly affect skeletal variation and are often overlooked in studies of morphological diversity.

Applying a number of diverse techniques (EM, microCT, tissue culture) to novel experimental data from mice and rabbits, we document variation in a series of intrinsic biological phenomena that can alter the functional signal conveyed by variation in skeletal structures: extracellular microenvironment, tissue mechanosensitivity, and rates of bone formation. Such factors can vary among skeletal sites and within a population, and thus significantly influence morphological variation independent of environmental stimuli. Combined with recent work on the multivariate nature of extrinsic effects on primate skeletal form, our findings suggests that static approaches to interspecific differences that fail to account for osteogenic processes and mechanisms have a higher likelihood of misinterpreting the functional signal from a given bony element.

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Addressing the Challenges of Missing Data in Anthropological Networks

ELSPETH READY[1], ASHLEY HAZEL[2] and JAMES HOLLAND JONES[2,3]

[1]Department of Sociology, University of Nebraska, [2]Department of Earth System Science, Stanford University, [3]Department of Life Sciences, Imperial College London

The study of interconnected relationships – i.e., social networks – has a long, though frequently forgotten, history in anthropology. The development of powerful statistical and computational tools for analyzing relational data has opened the door for understanding ethnographic networks, and the growing availability of open-source software has lowered the barrier to entry for anthropologists who want to conduct network research. However, as the field of network science has become more sophisticated, a growing mismatch has arisen between the underlying assumptions of statistical models for relational data and the limitations of field-collected, anthropological network data. The realities of ethnographic fieldwork usually require collection of incomplete networks based on strategic sampling methods, resulting in partial networks and extensive missing data. This missing data can lead to biased parameter estimates and even the failure of MCMC-based statistical models to converge to a solution. We describe the theoretical challenge and explain the field-sampling methods that lead to this problem. Many common ethnographic sampling designs turn out to be "ignorable" in the missing-data sense and this leads to straightforward corrections that remove bias and lead to good model fits. We illustrate these missing-data methods using comparative relational data on economic exchange and infectious disease transmission from a range of ethnographic contexts. Using network simulations, we show how different underlying social structures, when combined with different sampling designs, lead to the common missing-data problems. These insights should aid researchers in the formulation of more efficient ethnographic sampling designs.

Robust australopith paleobiology: The biogeography and paleoenvironments of eastern and southern African *Paranthropus*

AMY L. RECTOR and KELSEY D. O'NEILL

Anthropology, School of World Studies, Virginia Commonwealth University

Paranthropus boisei and *Paranthropus robustus* overlapped in time and shared derived morphology associated with heavy chewing. Their different geographic distributions, however, may have been concomitant with differing diets, niche spaces, and ecological contexts. Here, we combine paleocommunity analyses of *Paranthropus* faunal assemblages with biogeographic analyses to investigate the paleoecological contexts of these species, and how broad-scale African biogeographic patterns likely influenced their diverging habitats.

To compare paleoecological contexts, associated assemblages of large mammals from 11 South African and 6 east African *Paranthropus* sites were analyzed using a community approach. Multivariate correspondence analyses compared fossil communities to 191 extant communities in modern African habitats with known climatic variables. Using presence/absence data of 243 extant large mammal species and their locomotor and dietary adaptations, modern communities were described in terms of abiotic data, and this variability was used to retrodict ecological parameters for *P. boisei* and *P. robustus*. Biogeographic analyses included genus-level calculations of Dice and Simpson's faunal resemblance indices of >75

eastern and southern African fossil assemblages spanning the last 7+ million years.

Multivariate analyses suggest that while *P. boisei* sites were likely wetter over the course of the year, *P. robustus* sites were influenced more by seasonality in temperature and rainfall. Further, pan-African biogeographic patterns indicate that habitats, seasonality, and lineages began diverging between eastern and southern Africa ~3 million years ago. *Paranthropus boisei* and *Paranthropus robustus,* while both able to take advantage of a limited range of seasonal habitats, in fact existed in significantly different ecological and biogeographic contexts.

Dietary estimation of the Cercopithecid taxa from the Woranso-Mille (3.2-3.5 Ma) locality, Ethiopia

HAILAY G. REDA[1], STEPHEN R. FROST[1], EVAN SIMONS[1] and YOHANNES HAILE-SELASSIE[2]

[1]Anthropology, University of Oregon, [2]Physical Anthropology, Cleveland Museum of Natural History

Recognition of *Australopithecus deyiremeda* and the Burtele Foot from 3.3-3.5 Ma horizons at Woranso-Mille raises questions about paleoecology in the Afar Basin at the time. Cercopithecids have been shown to be useful paleoecological indicators. We compared 3.3-3.5 Ma Woranso-Mille ceropithecids with those from broadly contemporary Afar sites (3.6-3.8 Ma Woranso-Mille, Hadar, and Maka) using species richness, body mass and diet. Body masses were estimated using equations from Delson et al. (2000). Diet was estimated using lower third molar basal flare and cusp height ratios. These ratios were calculated for 303 LM3s of 22 extant species; 18 and 15 with dietary percentages of fruit and leaves, respectively, taken from the literature. Flare was only weakly associated with dietary fruit (R^2= 0.1674, P-Value= 0.0917), but relative cusp height was correlated with both fruit (R^2=0.2809, P-Value= 0.0236) and leaves (R^2= 0.3054, P-Value= 0.0148). Regression was then used to estimate leaf and fruit percentages for fossil taxa based on 60, 32, 26, and 7 LM3s from 3.6-3.8 Ma Woranso-Mille, Hadar, 3.2-3.5 Ma Woranso-Mille, and Maka respectively. While all were broadly similar with *Theropithecus* being relatively large and folivorous (i.e. grass-eating), moderately folivorous colobines, and more frugivorous papionins. The 3.3-3.5 Ma Woranso-Mille cercopithecids are, however, distinct as they don't overlap in percentages of fruit and leaf consumption among individual species that might suggest lack of strong competition for similar resources. In contrast, individual species in the other sites show an overlap in the percentage values although this is pronounced between Hadar *T.o.darti* and *Cercopithecoides meaveae*.

Social relationships between orphaned chimpanzee siblings at Ngogo, Kibale National Park, Uganda

RACHNA B. REDDY and JOHN C. MITANI

Department of Anthropology, University of Michigan

Young primates grow up slowly and receive considerable care from their mothers even after weaning. Yet, even after losing their mother, orphans of many species can survive and in some cases receive care from other individuals. In chimpanzees, this care seems integral to the survival of orphaned juveniles, whose chance for survival is almost always assured if they are "adopted" by a mature maternal sibling. Here, we investigate the social relationships between orphaned siblings at Ngogo in Kibale National Park, Uganda. From 2014 – 2017, nine adult females died, leaving 11 dependent offspring, most of which had older maternal siblings in the group. We present data on all 11 orphans, but focus on four adolescent and young adult male chimpanzees. These males lost their mothers in 2017 and had younger maternal siblings in the group. We compare the social relationships between these four orphaned subjects and their younger maternal siblings with the relationships between 18 non-orphaned adolescent and young adult males and their younger maternal siblings. Most orphaned chimpanzees frequently groomed with their maternal siblings. They also engaged in reassurance behavior and maintained close spatial proximity to their maternal siblings. In some cases, grooming, reassurance, and spatial proximity increased after the death of mothers. Older siblings were extremely vigilant and protective. They watched their younger siblings during group travel and occasionally defended them against aggression. Results from this study suggest that after losing their mother, orphaned chimpanzee siblings provide each other significant, perhaps crucial, emotional support and security.

This project was supported by the National Science Foundation, the National Geographic Society, the Leakey Foundation, the Nacey-Maggioncalda Foundation and the University of Michigan.

Big Questions and Bigger Data: Solutions to the problem of data integration for addressing major questions in human evolution

DENNE REED

Anthropology, University of Texas at Austin

The future of paleoanthropology lies with our ability to address big-picture questions by integrating heterogeneous data from disparate sources. For example, simply cataloging early hominin fossils from Africa and their distribution in space and time is difficult because the necessary information is spread across numerous institutions.

This paper demonstrates data integration using PaleoCore (http://paleocore.org), an open-source, geospatial data management infrastructure. Hominin fossil specimen data, taxonomic designations, locations, geological contexts, dates, anatomical descriptions, measurements, images, and bibliographic references were aggregated from publicly available online resources. These data were cleaned, and aligned to the paleocore data standard and conceptual data model to produce a comprehensive digital catalog of over 2700 hominin fossils recovered from over 20 African sites in the time span between the Late Miocene to the start of the Pleistocene (Messinian to Gelasian stages, ca 7.25 - 1.8 Ma). This database was used to calculate and visualize the temporo-spatial distribution of hominin fossils during this time span.

The database marks the first phase of a broader initiative to document the entire hominin fossil record, and to link hominin fossils to a wider host of archaeological, geological, climatic and ecological data using linked open data protocols and facilitated by machine learning algorithms. This digital infrastructure provides the foundation for the collaborative efforts of research consortia now coming together to address broad questions in human evolution and to fulfill the vision of developing comprehensive evolutionary explanations for the patterns we observe in the paleoanthropological record.

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Plio-Pleistocene climate proxies and hominin evolution in East Africa

KAYE E. REED[1], DAVID A. FEARY[2], JOHN ROWAN[1] and CHRISTOPHER J. CAMPISANO[1]

[1]Institute of Human Origins and School of Human Evolution and Social Change, Arizona State University, [2]School of Sustainability and School of Earth and Space Exploration, Arizona State University

Experimental studies suggest that the evolutionary success of C_4 grasses in tropical environments is in part due to a greater physiological tolerance for low CO_2 levels compared to C_3 plants (i.e., trees and shrubs). Such studies predict that C_4 biomass inversely tracks atmospheric pCO_2 levels through geological time, which should be reflected in the structure of terrestrial ecosystems, including mammal communities. We apply these conclusions to the Plio-Pleistocene fossil record of East Africa to better characterize environmental parameters as hominins evolved. We used mammalian species occurrence and dietary data from 96 eastern African fossil sites as a proxy for grassy versus woody habitats, and pCO_2 data were derived from ice cores (back to 800 ka), and boron-based proxies for the older record.

We show a statistically significant inverse relationship between deviations in pCO_2 and grazer abundances (r=-0.36, p=0.002) over the last ~4.5 Ma; before 3.4 Ma grazers comprise <20% of the total fauna when pCO_2 is >250 ppm, and before 1 Ma they are <32% when $pCO2$ is <200 ppm. In contrast, browsers often exceed 30% of the total fauna before 3.4 Ma, but decline when pCO_2 drops below 250 ppm. *Australopithecus* appeared in eastern Africa when pCO_2 was greater than 350 ppm, and *Homo* appeared at <300 ppm coincident with grassland expansion. Our findings have important implications for the role of paleoclimate in human evolution, as well as for the future stability of eastern Africa's grassland habitats in the face of CO_2 increases over the next century.

This project was supported in part by NSF BCS 1460493 and the John Templeton Foundation.

Sex and Status: Childhood Mortality Risk During the Industrial Era

SARAH REEDY

Anthropology, University of MA, Amherst, Sociology and Criminology, Quinnipiac University

Exposure to poor environments, malnutrition, and labor during childhood can lead to an increased risk of mortality. Studies of skeletal samples from Industrial Era Europe show stunted growth and increased morbidity when compared to Medieval samples, suggesting harsher conditions. While poor conditions can negatively impact the survivability of all children, boys may be particularly disadvantaged, because girls can reserve nutritional components buffering them during times of stress.

This study examines the effects of environmental stress on the survivability of children (0-18 years) in three Industrial European skeletal samples from varied SES backgrounds. Stress markers (CO, PO, LEH, and periostitis) were scored and Kaplan-Meier analysis was used to test the following hypotheses. H1) Lower SES children will exhibit greater risk of mortality than higher SES children. H2) Boys will exhibit greater risk of mortality than girls. H3) Those who display evidence of stress will have a higher risk of mortality than those who do not.

Surprisingly, results show that low SES children displayed the greatest survivability compared to middle and high SES children. Boys do exhibit a greater risk of mortality though results were not statistically significant. As expected, those with CO and PO had a greater risk of mortality than those without. However, children who display LEHs had the greatest survivability. These results suggest those who survive early childhood stress have greater overall survivability.

This research was funded through the Cultural Heritage in European Societies and Spaces (CHESS) Program, University of Massachusetts, Department of Anthropology, NSF grant IIA-1261172.

Getting in the zone: A discussion on the significance of double-zonal osteons

FRANZISKA D. REICHERT and DAWN M. MULHERN

Anthropology, Fort Lewis College

Currently, there are conflicting explanations about the possible significance of double-zonal osteons, which represent a type of secondary osteon with two arrest lines. Some scientists suggest arrest lines result from nutritional stress, whereas others think they form due to normal physiological processes, specifically the refilling of larger osteons. To test the latter possibility, size differences were compared between double-zonal osteons and secondary osteons without a second arrest line collected from 50 rib thin sections from a medieval skeletal sample from Kulubnarti, in Sudanese Nubia. There were no significant differences found between secondary osteons and double-zonal osteons in overall area, bone cross sectional area, or perimeter. However, Mann Whitney U tests showed that Haversian canal area and perimeter were significantly smaller in double-zonal osteons compared to other secondary osteons in this sample ($p<0.005$). The results of this study indicate that arrest lines are not more likely to be found in large osteons, so double-zonal osteons cannot be explained by a temporary pause in the refilling of a particularly large osteon. Haversian canals may be smaller in double zonal osteons because the second arrest line results in a functionally smaller osteon that requires less nutrients, which is consistent with the suggestion that double-zonal osteons are indicative of nutritional stress. This is an interesting finding that needs to be explored further. Understanding the underlying reasons for the development of specific histologic structures is important because they can be used to interpret aspects of nutrition, behavior or genetics in past populations.

Limb skeletal diversity among arboreal quadrupeds and its correspondence to variation in overall locomotor repertoire

THOMAS R. REIN

Department of Anthropology, Central Connecticut State University

Anthropoid primates that are commonly categorized as arboreal quadrupeds perform a range of additional locomotor behaviors including climbing and leaping. While arboreal quadrupedalism constitutes the highest proportion of the movements each of these species perform, relative proportions of climbing and leaping vary across these taxa. The objective of this study was to enhance our understanding of how skeletal shape variation corresponds to subtle differences in the relative degree to which arboreal quadrupeds rely on these other behaviors. Twenty-five measurements were collected with digital calipers on the femur, humerus, and ulna of specimens representing eight anthropoid species. Taxa were placed in categories that accounted for the relative proportions of different movements each has been observed to perform. One-way analysis of variance was used to examine potential functional and phylogenetic signals present in size-corrected shape variables. The majority of measurements did not distinguish arboreal quadrupeds that varied in the relative use of climbing and leaping. Several traits, however, including the degree of anteroposterior compression of the proximal and distal ulna, were clearly different among species that varied in performance of leaping and climbing regardless of their phylogenetic position. These differences could reflect adaptation to varying degrees of joint mobility in the forelimb during each of these behaviors. The results of this study illustrate the potential to infer more subtle aspects of the overall locomotor repertoire of extinct anthropoid primates that often performed arboreal quadrupedalism but were adapted to a wider range of behaviors.

This study was funded by a CSU-AAUP Faculty Research Grant.

Evaluating lead isotopes in Mediterranean paleomobility research: A case study in 5th c. BCE Greek Sicily

KATHERINE L. REINBERGER[1], LAURIE J. REITSEMA[1], BRITNEY KYLE[2], PIER FRANCESCO FABBRI[3], STEFANO VASSALLO[4], GEORGE D. KAMENOV[5] and JOHN KRIGBAUM[6]

[1]Department of Anthropology, University of Georgia, [2]Department of Anthropology, University of Northern Colorado, [3]Department of Cultural Heritage, Università del Salento, [4]Archaeological Heritage Section, Superintendency of Palermo, [5]Department of Geological Sciences, University of Florida, [6]Department of Anthropology, University of Florida

This study critically evaluates the use of lead isotopes in human skeletal remains from the Mediterranean. Lead isotopes (20nPb/204Pb) are useful indicators of movement patterns because the values in tooth enamel reflect the local geology on which a person lived when they were young and is incorporated into skeletal remains through ingestion. While oxygen and strontium isotopes have been successful in paleomobility research, in some regions of the world there is overlap in values of individuals from different sites because of various cultural and environmental factors. This is especially problematic in the Mediterranean where most of the population was living along the coast, where both δ18O and 87Sr/86Sr values can be similar. This research investigates whether lead can be useful for distinguishing non-local from local individuals in the Mediterranean region.

The need for more resolution between locals and non-locals is readily apparent in a case study

that investigates geographic place of origin of soldiers from the Battles of Himera (480 BCE, 409 BCE) and civilians buried at the Greek colony site of Himera in Sicily. This paper compares the lead isotopes for the two battle contexts and the contemporaneous local population. Tooth apatite was sampled for lead isotope ratios (Total sample mean: 206Pb/204Pb=18.84±0.12). Preliminary results suggest lead isotopes reveal further clarity for distinguishing locals and non-locals at Himera. This study strengthens our understanding of population movement in Sicily and provides a case study in the usefulness of lead isotopes in paleomobility research in the Mediterranean.

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Investigating DNA methylation of telomere-related genes in mothers and their newborns

PETER H. REJ[1,2,3], DAVID A. HUGHES[4], NICOLE C. RODNEY[2,3,5], DARLENE A. KERTES[3,6] and CONNIE J. MULLIGAN[2,3]

[1]Anthropology, University of Washington, [2]Anthropology, University of Florida, [3]Genetics Institute, University of Florida, [4]School of Social and Community Medicine, University of Bristol, [5]Research Department, Jung Tao School of Classical Chinese Medicine, Sugar Grove, NC, [6]Psychology, University of Florida

Telomeres contain non-coding repeated DNA sequences that buffer the ends of chromosomes from nucleotide loss during cellular replication. As such, telomere length (TL) shortens with age. Shortened telomeres also associate with psychosocial stress exposure. Working with a population of mother-newborn dyads from the Democratic Republic of the Congo, we previously found that maternal war stress associated with both cord blood and placental TL. Here we investigate if maternal stress alters DNA methylation of telomere-related genes, including the subunits of telomerase, the enzyme complex that rebuilds telomeres.

In the current pilot study, DNA methylation at 11 telomere-related genes was measured in blood and placenta samples collected from 24 Congolese mother-newborn dyads. Chronic maternal stress associated with DNA methylation at the telomerase inhibitor *TERF2* in the placenta only (p=6.750E-4). Placental methylation at two genes (*TERT* [p=1.260E-4] and *POT1* [p=8.640E-5]) also associated with birth weight. *TERT* codes for the catalytic component of telomerase, while *POT1* encodes an important telomerase inhibitor. Increased telomerase activity in the placenta has been linked with larger birth weights. Methylation at none of the tested genes associated with TL. Our preliminary results suggest that DNA methylation of telomere-related genes in the placenta may play a role in mediating the effect of maternal stress on birth weight although any link with TL is still unclear.

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Cranial Morphological Variation in the Americas: Where does Mexico fit in?

SAMUEL R. RENNIE[1], MARGARET CLEGG[2] and SILVIA GONZALEZ[1]

[1]Research Centre in Evolutionary Anthropology and Palaeoecology, Liverpool John Moores University, [2]Department of Genetics, Evolution and Environment, University College London

Early migration into the Americas' has primarily focused on using data from specimens in the USA or South America with very little focus on Central American countries. This preliminary study revolves around a comparison of Mexican samples and data from Howells Cranial Dataset.

Craniometric data were sourced from peer-reviewed published articles and books. From this, crania from Coahuila (MX) (1-2kya), Central Mexico (MX) (10-12kya), South Dakota (USA) (<1kya), Santa Cruz (USA) (<1kya), and Peru (PE) (1kya) were analyzed. To utilize the full data set (n=387), missing data were replaced by running a k Nearest-Neighbor (kNN) analysis which made it possible to compute the PCA.

The results from the PCA show two clear separations. Along PC1, separation between the sexes was evident. Approximately seven cranial variables drive the variation between males and females being ZYB, NLH, FRL, BNL, NPH, GOL, and BBH. Along PC2, separation between the Mexican samples and those from the Howells Dataset can be seen with the variables MAB, NOL, and DKB driving the variation. It is possible that PC2 shows how the cranium changed through time as the Mexican samples are ³1kya whilst the samples from Peru, Santa Cruz, and South Dakota are <1kya. It is evident that it is not just one area of the cranium that changes, but a mosaic of changes is occurring. With the splanchnocranium and neurocranium driving the variation between samples.

To continue this study, a larger Mexican sample is needed alongside samples that both predate and postdate the Spanish colonization.

Sexual dimorphism in an expanding *Au. afarensis* assemblage

PHILIP L. RENO

Bio-Medical Sciences, Philadelphia College of Osteopathic Medicinea

Body size dimorphism is commonly used to infer social and reproductive behaviors in *Australopithecus afarensis*. The *Au. afarensis* assemblage contains two small-bodied (A.L. 288-1 or "Lucy" and A.L. 128/129) and a large-bodied (KSD-VP-1/1 or "Kadanuumuu") associated skeletons. These specimens have been influential to both perceptions and quantitative analyses concluding that *Au. afarensis* was highly dimorphic. However, accurately inferring sexual dimorphism requires a large and broad sampling from across the assemblage. Fortunately, the existence of numerous isolated specimens, in conjunction with the Lucy or Kadanuumuu skeletons, enables the application of the robust Template Method. This method uses ratios between metrics of individual fossils and homologous sites on a template specimen (i.e., Lucy or Kadanuumuu) to assess dimorphism. Using the full assemblage (N = 42) with Lucy as a template, *Au. afarensis* dimorphism is similar to that of modern humans and dissimilar to either minimally dimorphic chimpanzees or highly dimorphic gorillas. The use of Kadanuumuu as a template limits the analysis to a smaller sample size (N = 14) that fails to distinguish between human and gorilla degrees of dimorphism. However, the use of Lucy as a template on this more limited sample provides similar results demonstrating the size of the template has no effect on the inferred dimorphism. The results from the full *Au. afarensis* sample indicate the species was characterized by moderate body size dimorphism. This, in conjunction with the extreme reduction of the canine, suggests that *Au. afarensis* was characterized by low inter-male aggression and competition.

Maternal Motives Behind Elective Cesarean Sections

EMALINE M. REYES[1] and KAREN R. ROSENBERG[2]

[1]Anthropology, University of Delaware, [2]Anthropology, University of Delaware

The WHO recommends a target cesarean section rate of 15% of all births. In recent years, the US has a rate of 33% and some other developed countries are even higher. Trevathan has argued that as a result of the complicated and relatively risky way humans give birth, humans benefit from assistants providing both logistical and emotional support. Our hypothesis is that women who are more likely to elect cesarean section for non-medical reasons do so at least in part because of unallayed fears and anxieties.

Our survey investigates women's birth preferences and attitudes towards birth. Our sample was young, American women who have not previously given birth but who may in the near future (N = 333). Those leaning toward C-section were more likely to be extremely fearful of birth (55%) than those leaning towards vaginal delivery (21%). 72% of the cesarean section group state that fear is what influenced their birth preference, 14% said their fear had no influence, while in the vaginal birth group 19% said fear did influence their birth preference and 55% said it did not.

In our sample, women likely to elect cesarean sections in the absence of medical necessity are motivated at least in part by fear. They report more extreme fear than the group anticipating non-surgical delivery; it is more likely that fear influences their birth decision. This study provides a better understanding of why women actively elect cesarean sections and offers productive low-tech and inexpensive ways to address their fears.

Social Networks and the Distribution of Wealth in a Matrilineal Mosuo Community

ADAM Z. REYNOLDS[1], SIOBHÁN M. MATTISON[1], MENG ZHANG[1], CHUN-YI SUM[1], MARY K. SHENK[2] and TAMI BLUMENFIELD[3]

[1]Department of Anthropology, University of New Mexico, [2]Department of Anthropology, Pennsylvania State University, [3]Department of Asian Studies, Furman University

Social and economic inequality is known to have a number of fitness-relevant consequences for reproductive success, health, and well-being. Here we investigate how social networks facilitate or constrain levels of inequality and determine who is able to access and accumulate material wealth. While some anthropological theories focus on the potential for cooperation to level inequalities by transferring resources from households at higher economic strata to those at lower strata, other theories have focused on the potential for social capital to be transformed into economic resources, suggesting that those who are able to position themselves centrally should be able to accumulate the largest surpluses of material wealth. Using data from a complete census of a matrilineal Mosuo community in southwest China taken in 2017, we apply tools from social network analysis to examine the relationship between household material wealth and positioning in social networks. We find a non-monotonic relationship between wealth and centrality, suggesting that greater access to social networks increases wealth for those at the bottom of the economic hierarchy, but decreases wealth for those at higher strata. We present alternative models of strategic relationship formation and dissolution, comparing these models in terms of their ability to reproduce the observed network structure, distribution of wealth, and correlations between household position and material wealth. We emphasize kinship, household ecology, and the economics of life history to explain variation in network formation strategies.

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The genetic impacts of sociopolitical change: investigating temporal shifts in central Mexico with paleogenomic evidence from Xaltocan

AUSTIN W. REYNOLDS[1,2], JAIME MATA-MÍGUEZ[2], ENRIQUE R. RODRIGUEZ-ALEGRÍA[2], LISA OVERHOLTZER[3], NADIN ROHLAND[4], DAVID REICH[4,5,6] and DEBORAH A. BOLNICK[2,7]

[1]Department of Integrative Biology, University of Texas at Austin, [2]Department of Anthropology, University of Texas at Austin, [3]Department of Anthropology, McGill University, [4]Department of Genetics, Harvard Medical School, [5]Broad Institute of Harvard and MIT, [6]Howard Hughes Medical Institute, [7]Population Research Center, University of Texas at Austin

Over the past thousand years, the town of Xaltocan in central Mexico has been affected by a series of sociopolitical transitions. Xaltocan expanded during the 10th-13th centuries and became a regional capital. It was then conquered by the Tepanec state in 1395. Xaltocan was later incorporated into the Aztec empire in 1428 before being conquered by the Spanish in 1521. Changes in material culture associated with these events have been investigated archaeologically, but many questions remain about how the residents of Xaltocan changed throughout these periods.

Past genetic work characterizing uniparental markers (Y-chromosome and mitochondrial DNA) in both ancient and contemporary inhabitants of Xaltocan has revealed genetic discontinuities likely associated with the Tepanec, Aztec, and Spanish conquests. In order to confirm the patterns suggested by uniparental markers and further explore the relationship of the ancient residents of Xaltocan with modern groups in Mexico, we collected paleogenomic data from the ancient remains with the best DNA preservation.

Here we present genomic data from 19 ancient individuals, spanning these time periods at Xaltocan. Approximately 1.24 million genome-wide SNPs were targeted for capture, with an average recovery of ~228k SNPs per individual. Genomic comparisons with modern populations show that many ancient Xaltocan residents are more closely related to other groups in Mexico than they are to the present-day residents of Xaltocan. Preliminary comparisons of ancient individuals also show genetic differences between different periods at Xaltocan. These results indicate that each sociopolitical transition at Xaltocan also resulted in genetic discontinuities in this town.

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Is Genetic Drift to Blame for a High Incidence of Testicular Dysgenesis Syndrome in Semliki Chimpanzees (*Pan troglodytes schweinfurthii)?*

ALICIA M. RICH[1], CAROLINE DEIMEL[1], FREDERIKA KAESTLE[1], SCOTT K. BREEDEN[2], MICHAEL D. WASSERMAN[1] and KEVIN D. HUNT[1]

[1]Anthropology, Indiana University, [2]College of Osteopathic Medicine, Marian University

Here we present three likely cases of testicular dysgenesis syndrome (TDS) within one community of wild eastern chimpanzees (*Pan troglodytes schweinfurthii*) living in the Toro-Semliki Wildlife Reserve in western Uganda. We present several hypotheses to explain the incidence in this population, and begin by testing whether genetic drift may be the culprit, as it has been suspected to account for high rates of TDS among other wild animals. We collected 78 noninvasive DNA samples and sequenced a 367-bp segment spanning the first hypervariable region within the D-loop of the mitochondrial genome. Within that 367-bp sequence we found 24 polymorphic sites consisting of 7 singletons and 17 parsimony informative sites. This sample contained 9 distinct haplotypes with a diversity index of 0.78 (SD=0.03). All tests (Tajima's D, Fu and Li's D* and F*) against the null hypothesis of neutral polymorphisms were non-significant (p>0.10). The mismatch distribution of pairwise differences does not fit a Poisson curve (SSD=0.12; p=1); therefore we failed to reject the null hypothesis of random mating and relative population stasis. These results fell well within the ranges we calculated for other populations of eastern chimpanzees. Thus, the Semliki chimpanzees do not show any signs of genetic isolation, population expansion, or a genetic bottleneck. Instead, they appear to be in a relatively static equilibrium. The possible causes and consequences specific to this population are discussed. Environmental toxicology offers some especially plausible culprits, which will be investigated in the future.

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Toward a more "engaged field primatology": Communicating, engaging, and collaborating with diverse publics

ERIN P. RILEY, KATHERINE T. HANSON, KRISTEN S. MORROW and ALISON A. ZAK

Anthropology, San Diego State University

Field primatologists are increasingly realizing that primate fieldwork not only involves themselves as the scientists and their primate study subjects, but other human publics whose lives and livelihoods are often impacted by the very research they conduct. Drawing from our field research in Sulawesi, Indonesia, we explore some of the challenges we have faced in navigating diverse publics that include other researchers (local and foreign), local community members, and government officials. Specifically, we critically examine the process of trust building that occurs between primatologists and the field assistants we hire, and how to effectively communicate and explain our research and the technology that accompanies it with others not immersed in the values,

perceptions, and methods of Western science. Additionally, reflecting on a recent shift toward frequent road side food begging behavior by moor macaques (*Macaca maura*) at our field site in South Sulawesi and the provisioning by people that has ensued, we highlight the disparate perceptions and reactions to this new human-primate interface and examine the challenges encountered when trying to develop ways to manage it. We argue that in order to effect a more "engaged field primatology," field primatologists need to appreciate how local people/field assistants are also producers of knowledge and ensure that their voices are audible in the work we do, and commit to communicating our research objectives and findings via multiple platforms to foster greater public support and appreciation.

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Teaching about primates with documentary film: Examining anthropology instructors' use of films and introducing the Primate Films Database

CRYSTAL M. RILEY KOENIG[1], BRYAN L. KOENIG[2] and CRICKETTE M. SANZ[1,3]

[1]Anthropology, Washington University in St. Louis, [2]Psychology, Southern Utah University, [3]Congo Program, Wildlife Conservation Society

The rapid development of technology over the past few decades has contributed to dramatic changes in college classrooms. In particular, use of multimedia has become commonplace in many disciplines. Films have been increasingly integrated into classroom instruction, and may be especially helpful for communicating about non-human primates, with which students likely have limited experience. In order to better understand the use of primate documentary films in the teaching of college-level anthropology, we conducted an online survey of 219 anthropology instructors. The vast majority of respondents (96.3%) reported using such films in their classrooms. The most widely shown documentaries featured many primate species, were easily accessible, and were highly rated by respondents for teaching usefulness. The following four films were shown by more than 36% of the respondents, featured many species, and were exceptionally highly rated for teaching usefulness: *BBC Life: Primates, Life on Earth: Life in the Trees, The Life of Mammals: Social Climbers,* and *Nature: Clever Monkeys*. To increase awareness about the multimedia resources available to anthropology instructors (and instructors in related fields) for teaching about primates, we created the Primate Films Database. The Database is a freely available online resource with information about documentaries featuring free-ranging primates. It includes information about film runtimes, primate species featured, instructor ratings, and film reviews. The Database will be updated biannually to include newly released films and can be accessed at https://anthropology.artsci.wustl.edu/primate-films-database.

Daily food sharing in nonindustrial societies: effects of subsistence ecology, food storage technology, and spatial/phylogenetic distance

ERIK J. RINGEN and ADRIAN V. JAEGGI

Anthropology, Emory University

While some degree of beyond-household food sharing is ubiquitous across nonindustrial societies, only a relatively small minority of societies customarily share food on a daily basis. Daily food sharing is predicted when 1) there is daily household-level variation in food production, 2) that variation is relatively uncorrelated across households, and 3) other means of smoothing consumption (such as storage) or commodifying food (such as external trade) are lacking. Using a sample of 70 societies from the Standard Cross Cultural Sample, we model the relationships between daily food sharing customs and various factors capturing these predictions such as subsistence strategy, food storage technology, environmental productivity, and inter-community trade. We also control for spatial and phylogenetic autocorrelation among societies using a geographic distance matrix and a genetic/linguistic supertree. Information-criteria driven model comparison suggests that several covariates contribute to food sharing customs, with absence of food storage technology emerging as the strongest predictor. We also find evidence of substantial spatial and phylogenetic covariation between societies not explained by other covariates. These findings demonstrate the influence of subsistence ecology as well as cultural/technological innovations on cooperative behavior and reiterate the need to account for statistical non-independence in cross-cultural research.

A reappraisal of the relationship between first molar emergence age and brain mass in primates

TERRENCE B. RITZMAN[1,2,3], HALSZKA GLOWACKA[1] and GARY T. SCHWARTZ[4,5]

[1]Department of Neuroscience, Washington University School of Medicine, [2]Department of Anthropology, Washington University, [3]Human Evolution Research Institute, University of Cape Town, [4]School of Human Evolution and Social Change, Arizona State University, [5]Institute of Human Origins, Arizona State University

The long-established relationship between first molar (M1) emergence age and brain mass in extant primates is used to make inferences about ontogeny in extinct primates, including hominins. However, the potential influence of the phylogenetic relationships among primate taxa on this correlation is currently unknown. Furthermore, in recent years, new/updated M1 emergence age data have been reported for several hominoids. Here, we explore the effect of these new data and the potentially confounding effect of phylogeny on the established relationship between M1 emergence age and brain size; the effects of body mass and lifespan are also considered. Specifically, this study employs phylogenetic generalized least squares analyses on a sample of primates (n=27 species) using published data on M1 emergence age, brain size, body mass, and maximum lifespan. The results indicate that controlling for phylogeny reduces the correlation between M1 emergence age and brain size; however, this correlation is still strong and highly statistically significant (r=0.917; p<0.001). The correlation between M1 emergence age and brain size is also strong and highly significant when controlling for phylogeny and body mass (r=0.913; p<0.001) and maximum lifespan (r=0.911; p<0.001). These results show that the inclusion of updated data points and the effects of phylogeny do not appreciably affect and demonstrate that this relationship is robust to the confounding effects of body mass and lifespan. Therefore, this study justifies the continued use of the relationship between M1 emergence age and brain size to reconstruct life history in extinct primate species.

Fishing for farmers: a bioarchaeological study of maritime subsistence transitions in prehistoric Estonia and Latvia

MICHAEL B. C. RIVERA[1], GUNITA ZARIŅA[2] and JAY T. STOCK[1]

[1]Phenotypic Adaptability, Variation and Evolution (PAVE) Research Group, Department of Archaeology, University of Cambridge, [2]Institute of Latvian History, University of Latvia

Global transitions to agriculture have often been associated with deteriorating health, decreasing mandibular and dental sizes, and declining mobility with increased sedentism. However, coastal and marine ecosystems often provided richer and more varied sources of food, thus we may expect environmental factors to alter common trends locally. Human remains (n = 159) dated to the Estonian and Latvian Mesolithic, Neolithic, Bronze Age and Iron Age (9,000 BC—850 AD) provide a unique opportunity to elucidate subsistence transitions on the coast.

As is common with the introduction and intensification of farming, we document reductions in craniofacial and tooth sizes across all four periods, reflecting a greater reliance on softer or more processed foods. However, our data reveal several distinctive patterns that differ from typical trends: (i) more rigid and stronger humeri, femora and tibiae in Bronze Age individuals relative to Mesolithic and Neolithic hunter-gatherers and Iron Age farmers, (ii) moderate tooth wear and frequent calculus deposition throughout all ages,

(iii) consistently low rates of linear enamel hypoplasia, dental caries and periapical lesions, and (iv) the presence of auditory exostoses, suggesting habitual immersion in cold water. These trends suggest that Baltic farming communities were engaging in agriculture later than other newly farming populations, and continued to access nutritious, varied and low-sugar food, likely deriving from aquatic resources high in protein and consistently laden with sand and grit. Our findings reveal that water-based foods may have been supplemental to agricultural diets, buffering ancient Balts against nutritional issues common to non-coastal farming populations.

This project was funded by Sigma Xi, The Scientific Research Society, and both the Department of Archaeology and St. Catharine's College at the University of Cambridge.

Stick digging and the evolution of the australopith forelimb

NEIL T. ROACH

Department of Human Evolutionary Biology, Harvard University, Division of Anthropology, American Museum of Natural History

Digging up roots, tubers and burrowing animals is a crucial foraging behavior in many human societies. Such digging is labor intensive, calorically significant and often performed primarily by women. Among non-human primates, rare instances of digging for food are reported in capuchins and chimpanzees. Current theory also suggests that underground storage organs were a staple of the australopith diet. Despite the adaptive significant of underground foods, data on whether hominins ate such items are equivocal and how such foods were extracted remains unknown.

This study measures the biomechanics of stick digging and assesses the presence of digging behavior in the hominin fossil record. Kinematic data were collected from ten women and men tasked to simulate stick digging motions in the laboratory. To address the independent contributions of each arm, participants repeated the digging tasks using a sliding sleeve held in one hand, allowing one arm to contribute to power generation while both arms contributed to aim and stability. Force plate and kinematic data were integrated using inverse dynamics analysis to calculate joint velocity, torque, power and work.

Unexpectedly, near equal contributions to external work were found from both arms. However, that work was achieved very differently in each arm. The single largest work contribution came from elbow extension in the non-dominant arm. I conclude that subtle shifts in humeral and ulnar morphology in australopiths may reflect complex selection pressures for climbing retention and efficient digging. Implications for understanding the appearance of a sexual division of labor will also be discussed.

This project was supported by the National Science Foundation (BCS-1518596, PI: Roach) and the American School for Prehistoric Research.

"An Urgent and Growing Threat to Our National Security": Bioarchaeological challenges to the narrative of statehood and security in the face of climate change and crisis

GWEN ROBBINS SCHUG

Anthropology, Appalachian State University

For more than half a century, the scientific community has recognized that contemporary environmental problems have counterparts in the past. Anthropogenic, sociocultural, and "natural" factors have always been interwoven throughout the process of past civilizational collapse—dramatic reorganizations of systems of power and of human populations, often leading to settlement abandonment. Detailed archaeological and bioarchaeological investigation elucidates the complexity of socionatural phenomena, human resilience, habitus, and process of culture change but politicians and policy-makers do not read anthropology. The Human Security literature they rely on is based on deeply problematic assumptions about human evolution and "human nature," which have important ramifications in the attitude of working papers of the United States Department of Defense, among other agencies. This paper uses bioarchaeological evidence from two cases of environmental crisis in South Asian prehistory, an urban case spanning the collapse of the Indus civilization (2200-1300 BC) and a rural example from west-central India (1400-700 BC), to elucidate heterogeneity in human-environmental interactions and the specific ways different historical, social, and cultural circumstances intervene to shape long-term outcomes of different responses to crisis. Compiling data on demography, skeletal growth profiles, nutritional insufficiency, violence, infection, and changing mortuary and subsistence behaviors over a span of 1500 years, this paper characterizes the experience of resilience, demonstrates some of the trajectories of sociocultural change, and challenges the notion that societies choose to fail. Ultimately, these data demonstrate the importance of infusing anthropological perspectives in popular discourse on climate change.

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Conceptual approaches to the bioarchaeology of "community" care using knowledge from personal experiences of care giving

CHARLOTTE A. ROBERTS

Archaeology, Durham University

In 2014 a method applicable to the analysis of archaeological human remains was published for assessing care provision in past communities (www.indexofcare.org). The method was a more objective way of exploring care in the past, from a "patient" and community perspective. Since then the "Index of Care" has been applied to human remains from a range of regions and time periods. A focus on individuals rather than "populations" has been the norm, but bioarchaeologists should now be taking the next step and developing the approach at a population level. The individual approach is perhaps easiest, but even this can be very challenging. This presentation encourages practitioners to think about the nature of care giving based on experiences of care at the "population" level in a modern setting. It takes as its starting point increasing longevity in the western world and people living with multiple chronic conditions. Within care homes and hospitals care givers are constantly "managing" people with diverse medical histories and needs, but also dealing with people with the same diseases at different stages of progression, and their associated symptoms. Accommodating the multiple and different needs of each and every person, say in a care home, can be very challenging. From a bioarchaeological perspective, it is thus important to consider the challanges that staff in caring institutions face today in providing appropriate care for "populations" with complex needs. Suggestions for ways forward in bioarchaeology will be presented.

Assembling an album of primate-environment interrelations: Using the past to understand the present in order to address the future

JOSHUA R. ROBINSON

Department of Anthropology, University of South Carolina

One of the challenges we will face in 'ventilating' our research silos is how to incorporate disparate lines of climatic data in order to approach a comprehensive album of primate-environment interactions that can be used to engage the general public on meaningful topics related to the consequences of global climate change. Multi-method approaches to deciphering environmental and climatic conditions have become the norm across biological anthropology. We often grapple with the limitations of our data, particularly when it comes to mixing spatial and temporal scales and forms of indirect and direct data. Before synthetic conclusions of the role

of climate change in human and non-human primate lives can be derived it is imperative to determine how seemingly incompatible lines of evidence are related. To this end, examples of how different lines of evidence are complimentary and can be integrated to develop cohesive environmental models, including stable isotope (*n* = 22) data from the Holocene record of Lukenya Hill, Kenya, will be presented. The stable isotope evidence from Lukenya Hill indicates decreased woody cover on the Athi-Kapiti Plains over time in the Holocene which has implications for understanding the development of human herding communities in the region, and, potentially, the future of the ecosystem and modern human communities. As we establish cross-disciplinary lines of communication linking the past to the present and the future in framing biological anthropology's public message on global climate change, we will need to unravel the complexity of the spatial and temporal associations of ecological proxies.

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Quantifying free simple sugars in orangutan foods using spectrophotometry: Implications for orangutan feeding ecology

NATALIE J. ROBINSON, LEXI R. LANG, ERIN E. KANE and CHERYL D. KNOTT

Anthropology, Boston University

Orangutans (*Pongo pygmaeus wurmbii*) in Gunung Palung National Park, West Kalimantan, Indonesia experience significant seasonal and annual fluctuations in the availability of their preferred food, ripe fruit. When ripe fruit is limited, orangutans increase their consumption of bark, pith, and leaves, which are continuously available and may act as fallback foods. While these foods are presumed to be less nutritious, it is not clear whether this is the case. Free simple sugars (FSS) provide orangutans with readily-metabolizable energy, and are thus an important nutritional compound for food choice. Here, we examine FSS concentrations in a variety of orangutan foods (n=54) to better understand orangutan foraging and nutritional ecology. We predicted that preferred foods would have higher concentrations of FSS than fallback foods.

We analyzed FSS concentrations using a modified phenol-sulfuric acid method, and tested sample absorbency using a spectrophotometer at 490 nm. We analyzed 54 samples from 48 species, examining six plant parts: bark, flowers, leaves, pulp, seeds, and skin/pulp. Although preliminary results indicated no statistically significant differences in sugar content across the six food categories ($F(5,47)=1.78$, $p=0.14$), we did find that preferred foods (fruit pulp and seeds) had an average sugar concentration that was significantly higher (4.7%) than fallback foods (leaves and bark) ($t=2.355$, $p=0.04$).

Therefore, as predicted, we find that orangutans prefer food types with higher concentrations of FSS. Obtaining adequate caloric and nutritional intake is crucial for orangutan reproduction and development, and thus this study provides new insight into what drives orangutan dietary choices.

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Preliminary investigation of morphological integration between the talus, calcaneus and navicular of apes and humans

NICOLE L. ROBINSON and J. MICHAEL PLAVCAN

Anthropology, University of Arkansas

Analyses of morphological integration among primates commonly focuses on the relationships between the face, braincase and base of the skull, as well as the upper and lower dentition. These studies rarely include the post-cranial skeleton, but those that have focused on the pelvic girdle and the relationships between the upper and lower limbs. The associations between the bones of the hindfoot and their articular surfaces have largely been ignored among primates, even though the foot demonstrates high degrees of variation and modification. This adaptive variation allows us to study the relationship between morphology and locomotion, which can then be used to study the locomotion patterns of fossil hominins and apes and their unique characteristics. Because the articulations between the talus, calcaneus and navicular act together to stabilize the hindfoot in locomotion and form a direct interface with the substrate, the matching articular surfaces are highly integrated. This suggests that these surfaces form a complex structural unit rather than separate bones, for natural selection to influence. However, preliminary results suggest that there is no difference in correlation both within and between bones, where high correlations were found in most comparisons. Thus, the study of morphological integration of the talus, calcaneus, and navicular can help resolve the issue surrounding the development of a foot adapted for bipedal locomotion from a more primitive ape foot. While articular surfaces were expected to be more highly correlated, results demonstrate that integration within and between bones is no different.

Reconstructing admixture and migration dynamics of post-contact Mexico

JUAN ESTEBAN RODRIGUEZ-RODRIGUEZ[1], JAVIER BLANCO-PORTILLO[1], ALEXANDER IOANNIDIS[2] and ANDRES MORENO-ESTRADA[1]

[1]Human Population Genomics, LANGEBIO-CINVESTAV, Mexico, [2]Department of Genetics, Stanford University

Mexico has considerable population substructure due to historical events and different amounts of admixture between diverse human groups,predominately Native Americans, Europeans, Sub-Saharan Africans and, to alesser extent, East Asians. Using genome-wide SNP array data fromindigenous and admixed Mexican populations, we explored the ancestry tractlength distribution from 7 different states across Mexico to infer thetiming of admixture in each region, as well as the number of migratorypulses. We observed older admixture timings in the earliest colonialcities. We show for the first time a second pulse of combinedEuropean/Native American origin in the states of Guanajuato and Guerrero.Moreover, first admixture event predictions agree with historical records,reporting a considerable increase of the admixed population between1570-1646. In the other hand, we identified some individuals from Guerrerowith more than 5% of Asian ancestry. To trace the origin of thisunderstudied heritage, we compared the Asian-derived Mexican haplotypes with areference panel of Southeast and East Asian populations. Theseindividuals, particularly from the Pacific Coastal port of Acapulco,clustered with Indonesian and non-Negrito Filipino populations, suggestinga historical genetic record from the Manila Galleon trade betweenPhilippines and Mexico. These unexpected ancestries may have repercussionsin clinical genomics research as they have not been taken into accountconsiderably in these studies.

Supported by CONACYT grant CB-2015-01-251380 (Mexico) Evolutionary Genomic Analysis of indigenous populations from Mexico

Genetic evidence for early separation of Neanderthals and Denisovans and an early archaic bottleneck

ALAN R. ROGERS[1], RYAN J. BOHLENDER[2] and CHAD D. HUFF[3]

[1]Anthropology, University of Utah, [2]Epidemiology, MD Anderson Cancer Center, [3]Epidemiology, MD Anderson Cancer Center

Whole-genome sequence data allow us to reconstruct human evolutionary history in unprecedented detail. We use Legofit to study the past several hundred thousand years. Our results show that (1) the Neanderthal population was large and deeply subdivided; (2) Neanderthals and Denisovans separated early in the Middle Pleistocene; and (3) their ancestors survived a narrow bottleneck of population size. They also

(4) support previous estimates of gene flow from Neanderthals into modern Eurasians.

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Oxytocin- and Arginine Vasopressin-Containing Axonal Fibers in the Cortex of Humans, Chimpanzees, and Rhesus Macaques

CHRISTINA N. ROGERS[1,2,9], AMY P. ROSS[2,3,4], SHWETA P. SAHU[2], ETHAN SIEGEL[2], EDWARD G. STOPA[5], LARRY J. YOUNG[6,7,9], JAMES K. RILLING[1,6,7], H E. ALBERS[3,4] and TODD M. PREUSS[2,8]

[1]Anthropology, Emory University, [2]Division of Neuropharmacology and Neurodegenerative Diseases, Yerkes National Primate Research Center, [3]Center for Behavioral Neuroscience, Georgia State University, [4]Neuroscience Institute, Georgia State University, [5]Department of Pathology and Neurosurgery, The Warren Alpert Medical School, Brown University, [6]Center for Translational Social Neuroscience, Emory University, [7]Department of Psychiatry and Behavioral Sciences, Emory University, [8]Department of Pathology and Laboratory Medicine, Emory University School of Medicine, [9]Silvio O. Conte Center for Oxytocin and Social Cognition, Emory University

The nonapeptides oxytocin (OT) and arginine-vasopressin (AVP) are involved in the regulation of complex social behaviors across a wide range of taxa. OT and AVP influence social behaviors via release in the central nervous system, and their effects are mediated by the distribution of receptors across brain regions. In both rodents and primates, OT and AVP v1a receptors are found in regions far from the hypothalamic nuclei where the peptides are produced. This raises the question of how these peptides reach their remote receptors. To determine whether OT and AVP projections actually innervate the cortex in primates, we performed immunohistochemistry for fibers containing OT and AVP in 3 human, 3 chimpanzee, and 5 rhesus macaque brains in cortical regions relevant to social cognition. AVP fibers were observed in the subcallosal and olfactory cortex in all species, as well as in the insular cortex in humans, and in a more restricted distribution in chimpanzees. OT fibers were found orbitofrontal and anterior cingulate cortex in human and chimpanzee brains. Our results contrast with previous reports of OT and AVP immunohistochemistry in human and non-human primate brains, which either did not include cortical regions or did not report the presence of fibers in the cortex. Overall, our findings help to address the issue of how OT and AVP exert effects on brain regions far from the hypothalamus, particularly in primates, and provide evidence of species differences in OT and AVP neuroanatomy.

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Whole genome sequencing reveals ancient hybridization among baboon (*Papio*) species

JEFFREY ROGERS, R.ALAN HARRIS, MUTHUSWAMY RAVEENDRAN and KIM C. WORLEY

Human Genome Sequencing Center, Baylor College of Medicine

This presentation will summarize results from the international Baboon Genome Analysis Consortium, a group of more than 70 researchers from 8 countries who have collaborated to sequence, assemble and analyze the genome of the olive baboon, *Papio anubis*. The consortium has also analyzed whole genome sequence data from 15 *Papio* baboons representing all six *Papio* species, and one gelada (*Theropithecus gelada*) as outgroup. The *P. anubis* assembly is available at NCBI and was annotated to identify protein coding genes and non-coding RNAs. Baboons are well known to demonstrate current inter-species hybridization in several localities within Africa. The consortium investigators used multiple analytical approaches to investigate the possible impact of ancient inter-species hybridization on the distribution of genetic variation among extant lineages. The primary (basal) evolutionary divergence separates a lineage ancestral to three northern baboon species (*P. anubis, P. hamadryas, P. papio*) from a lineage ancestral to the southern species (*P. cynocephalus, P. kindae, P. ursinus*). The consortium found strong evidence from multiple data types (SNPs in putative neutrally evolving inter-genic regions, Alu insertion polymorphisms, others) and several analytical strategies (neighbor joining phylogenies, tree building accounting for ancient and current polymorphism within species, Bayesian concordance analysis, f-statistics) for several episodes of ancient inter-species hybridization, including one involving ancient north-south hybridization with substantial long-term impact. This presentation will summarize contributions from multiple laboratories and consortium investigators, describing specific results and the overall evolutionary scenario supported by these extensive data and analyses.

Childhood energetic and psychosocial stressors affect adult reproductive function

MARY P. ROGERS[1], KATHARINE MN. LEE[1], ANDRZEJ GALBARCZYK[4], GRAZYNA JASIENSKA[4], RIPAN S. MALHI[1,2] and KATHRYN BH. CLANCY[1,3]

[1]Department of Anthropology, University of Illinois, Urbana-Champaign, [2]Institute for Genomic Biology, University of Illinois, Urbana-Champaign, [3]Beckman Institute of Advanced Science and Technology, University of Illinois, Urbana-Champaign, [4]Institute of Public Health, Jagiellonian University

Age at first menses, or menarche, is correlated with reproductive function and used as a proxy of childhood stress. Few studies have examined relationships between developmental conditions and menarcheal age on reproductive function, particularly in transitioning environments like rural Poland where age at menarche is likely declining alongside socioeconomic growth.

Here we investigate if menarcheal age is declining in the rural Polish Beskid Wyspowy region. We investigate relationships between menarcheal age and proximate measures of energetic and immune stress (childhood farming and animal exposures) and psychosocial stress (adverse childhood experiences, ACE). We further test if childhood stress correlates with adult urinary estrone-3-glucuronide (E1G) concentrations.

Menarcheal age is declining over time (n=167, $p<0.001$). Women who grew up on farms with animals had later ages at menarche (n=86, $p=0.01$) and lower E1G concentrations in follicular (days -9 to -1, $p=0.005$), periovulatory (days -3 to 3, $p=0.009$), and luteal (days 1 to 9, $p=0.008$) phases. ACE did not independently correlate with menarcheal age or E1G concentrations. However, using step-wise regression by AIC, final models of periovulatory and luteal average E1G ($p<0.0001$, $R^2=0.61$; $p<0.0001$, $R^2=0.68$, respectively) included ACE scores, childhood and current farming variables, and current age.

In this region, menarcheal age was dependent on childhood energetic and immune exposures. However, childhood energetic, immune, and psychosocial stressors all affected adult ovarian function. The results of this study support a hypothesis that developmental conditions affect adult reproductive function, but challenge the use of age at menarche alone as a proxy for childhood exposures.

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Contribution of group composition to father-daughter mating in *Pan troglodytes*

SHANNON L. ROIVAS, KARA K. WALKER and ANNE E. PUSEY

Evolutionary Anthropology, Duke University

While inbreeding among maternal relatives is generally rare in chimpanzees, the prevalence of mating among paternally related dyads is not well understood. Preliminary evidence from the Kasekela community in Gombe National Park, the only chimpanzee community where mating among paternally related dyads has been examined, indicate that mating between father-daughter dyads occurs at a surprisingly high rate, even above that of mating between unrelated dyads. This begs further explanation given that inbreeding in chimpanzees has fitness consequences for any resulting offspring. Here

we sought to determine if the high mating rate between father-daughter dyads results from a dearth of unrelated estrous females available during a given mating event (i.e. fathers will mate with daughters when no or few other estrous females are available). Utilizing observational data from 30 years of study in Kasekela, we constructed generalized linear mixed models to examine the role of group composition on the likelihood of father-daughter mating events. Results indicate that the number of available estrous females and number of competing males do not influence the probability that a father-daughter mating will occur. A second analysis revealed that even high-ranking fathers, who are theoretically capable of competing for access to unrelated females, mate with their daughters. Overall, these results suggest that male chimpanzees in Kasekela are not avoiding inbred mating opportunities with their daughters and instead consider them attractive mating partners, contrary to expectation.

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Are humans overspecialized evolutionary "dead ends"?

CAMPBELL ROLIAN

Comparative Biology and Experimental Medicine, University of Calgary

Primate locomotion is frequently described as "generalized" or "specialized". The latter is often associated with unique limb proportions, implying a degree of evolutionary "commitment" in specific limb bone morphology, and in integration among limb bones. It is unclear, however, how much this commitment constrains the evolvability of the locomotor skeleton, i.e., its capacity to evolve in response to selection towards new adaptive peaks. I used evolutionary simulations to investigate how a primate's mean limb morphology and integration patterns influence its evolvability towards adaptive peaks representing alternative extant modes of locomotion. I used a diverse sample of catarrhine primates to derive initial populations with representative means and variance/covariance structures for each species, and let them "evolve" multiple times under identical simulation parameters towards the mean morphology of every other species. Simulations ran until populations reached the target phenotype, or went extinct. Results show that a generalized quadrupedal morphology is achieved rapidly by all morphotypes, but nonhuman primate populations frequently go extinct before achieving *Homo*-like limb proportions. In contrast, the structure of (co)variation in *Homo sapiens* rarely prevented it from evolving ape-like or generalized quadrupedal morphologies. Evolvability towards new phenotypes was not correlated with body size, distance in morphospace, or with integration strength, but with the orientation of the major axes of variation relative to target morphologies. Thus, extreme locomotor specializations may be relatively inaccessible in morphospace, but are not necessarily "dead ends". Instead, their evolutionary potential is determined mainly by the structure of phenotypic covariation among limb elements.

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A comparison of fluctuating asymmetry models in non-human primate crania

ASHLY N. ROMERO and CLAIRE E. TERHUNE

Department of Anthropology, University of Arkansas

Fluctuating asymmetry (FA) – random deviations from bilateral symmetry in an organism's paired features – is a good candidate for investigating developmental stability. This easily accessible measurement can be used to understand the relationship between stress and development across organisms, and growth rate plays a vital role in the accumulation of FA. Two models currently exist for predicting levels of FA in organisms: 1) FA accumulates and increases throughout ontogeny vs. 2) FA is compensated for and decreases throughout ontogeny. Few studies have investigated craniofacial FA in non-human primates, and those that have suggest the former model, thus predicting that longer and slower growing primates should exhibit higher levels of FA. This study examines craniofacial FA in two primate species (*Pan troglodytes troglodytes* and *Gorilla gorilla gorilla*; n=74, split equally among species/sex) to elucidate the effect of length and rate of growth on FA in apes. Results suggest that *Gorilla* exhibits higher levels of FA than *Pan*, and, on average, females within each species show higher levels of FA than males. These results suggest that species with slower growth (i.e., *Pan*) may have greater developmental stability and are potentially able to compensate for perturbations in growth throughout ontogeny. However, this model cannot explain the observed differences between FA in sexes. Further analyses will help tease apart the factors contributing to differential response to environmental and genetic stress to contribute to a broader understanding of primate canalization and developmental stability.

Diet through time in Cambridgeshire, England: Evidence from isotopic analysis and skeletal stature

ALICE ROSE, TAMSIN O'CONNELL, CRAIG CESSFORD, JENNA DITTMAR, SARAH INSKIP, TOOMAS KIVISILD, PIERS MITCHELL, BRAM MULDER, CHRISTIANA SCHEIB, JAY STOCK, MARY PRICE and JOHN ROBB

Department of Archaeology, University of Cambridge

The 'After the Plague' project aims to use multi-proxy analysis to investigate the long and short-term effects of the Black Death (1348-50) on the Medieval population of Cambridge, England. This is being investigated using osteoarchaeological, palaeopathological, isotopic, genetic, metrical and historical data. However, in order to fully understand and contextualise changes seen within the Medieval period, it is crucial to understand changes through deeper time in Cambridgeshire.

Research presented here brings together newly generated carbon and nitrogen isotopic data from Medieval and Post-Medieval skeletons with previous isotopic data from Roman and Anglo-Saxon skeletons from Cambridgeshire, revealing dramatic, statistically significant changes in both $\delta^{13}C$ and $\delta^{15}N$ through time. In particular, a significant increase in $\delta^{13}C$ and $\delta^{15}N$ ($p=<0.001$) was observed from the Anglo-Saxon to the Medieval period, which could suggest a substantial change in diet. Aside from genetic predisposition, diet is thought to play an important role in determining final achieved stature, therefore it was decided to further investigate the results of the isotopic data by compiling stature data from skeletal remains from across Cambridgeshire. However, the results did not follow the expected pattern, with a statistically significant increase in height occurring between the Roman and the Early Anglo-Saxon period ($p=<0.001$), followed by a decline in height in the Medieval period. This study further emphasises the importance of the isotopic change seen in the Medieval period and could indicate that genetics, particularly influxes of migrants, or stress, could be important factors affecting the stature of the population of Cambridgeshire.

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Male mountain gorillas' dominance hierarchies are not mediated by testosterone

STACY ROSENBAUM[1,2], RACHEL S. SANTYMIRE[2] and TARA S. STOINSKI[3]

[1]Anthropology, Northwestern University, [2]Davee Center for Epidemiology and Endocrinology, Lincoln Park Zoo, [3]Dian Fossey Gorilla Fund International, Atlanta, GA

Testosterone (T) mediates dominance hierarchies in many primate species. Among non-human great apes, three species (chimpanzees, bonobos, and mountain gorillas) live in multi-male groups with male dominance hierarchies. In chimpanzees, where male competition over mates may be highly aggressive, many studies have shown that higher-ranking males have higher T. The relationship between rank

and T is less clear in bonobos, where females are dominant over males and direct aggression between males occurs less often. For mountain gorillas, only one preliminary study (10 males, 205 urine samples; Robbins & Czekala 1997) has been published on the relationship between male rank and urinary T. Here, we re-examine the relationship between rank and T in five multi-male mountain gorilla groups monitored in 2003-05 and 2011-12 by the Dian Fossey Gorilla Fund International's Karisoke Research Center. Groups contained between two and eight males ages 10+ (n=27 males, 671 samples). After controlling for collection date and time, and males' age, in 2003-05, when males lived in larger groups with higher male:female ratios, there was no relationship between rank and testosterone. In 2011-12, when males lived in smaller groups with lower male:female ratios, there was a trend for alpha males to have higher T values than males who were ranked 4th or lower in their social group. All other differences were non-significant. Results suggest that males' dominance hierarchies are not mediated by T in this species, even though current theory would predict T mediation due to male gorillas' extreme adaptations for physical competition with other males.

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The legacies, context, and consequences of cooperative childbirth

KAREN R. ROSENBERG[1] and WENDA R. TREVATHAN[2]

[1]Anthropology, University of Delaware, [2]Anthropology, New Mexico State University

Childbirth is often the most emotionally and physically challenging event of a woman's lifecourse. Cooperative behavior facilitates many aspects of our daily lives (such as hunting, gathering, house building, childrearing) and this is especially true of human birth in which outcomes are usually better when women receive physical assistance and emotional support. However, medicalization of childbirth has taken the physical aspects of assistance to the extremes, while ignoring the importance of social and emotional support. This often leaves women in clinical settings feeling anxious and afraid. When the deeply-rooted need for emotional support and cooperative assistance is not met, extreme intervention up to and including elective cesarean section may result, contributing to some of the increase in c-section rates seen in many developed nations today. Although these interventions are often life-saving for mothers and infants, they also come with risks and added costs for both parties. An understanding of human evolutionary history, (particularly bipedalism, placental development, and encephalization), elucidates both why *inaccessibility* of safe, surgical deliveries contributes to high maternal and infant morbidity and mortality in some parts of the world, but an *excess* of surgical deliveries impacts health negatively elsewhere. We argue that addressing women's emotional needs in modern clinical settings by providing social support offers an effective way to reduce the frequency with which women request or acquiesce to elective cesarean sections.

Neurogenetic roots of language: *KIAA0319* SNP variation associated with aspects of brain morphology in chimpanzees

MADELEINE ROSENSTEIN[1], NICKY STAES[1], STEVEN J. SHAPIRO[4], WILLIAM D. HOPKINS[2,3], CHET C. SHERWOOD[1] and BRENDA J. BRADLEY[1]

[1]Center for Advanced Study of Human Paleobiology, The George Washington University, [2]Neuroscience Institute and Language Research Center, Georgia State University, [3]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center, [4]Michael E. Keeling Center for Comparative Medicine and Research, University of Texas MD Anderson Cancer Center Bastrop, TX

Understanding how genetic variation shapes primate brain morphology can provide insight into the evolution of human cognition and language. Numerous genes have been identified that play a role in brain development, social cognition, and learning. In humans, the gene *KIAA0319* is associated with dyslexia susceptibility. Magnetic resonance imaging of typically developing humans and diffusion tensor imaging of dyslexic humans show an association of *KIAA0319* variants with white matter connectivity and asymmetry of the inferior frontal gyrus. Thus, *KIAA0319* plays a critical role in the development of neural circuits importance in language processing. However, the extent of natural variation in this gene in other primates is poorly understood. First, based on chimpanzee sequence data, we identified an A/C SNP in exon 10 of *KIAA0319*, which changes an amino acid from an Aspartic acid to a Glutamic acid (D563E). Then we used high-resolution melt analysis to genotype 321 chimpanzees and examine potential associations between variation in this coding region and brain structure. Genotype frequencies were in Hardy Weinberg equilibrium (X^2=0.53, df=1, p=0.47) with the ancestral allele present at a slightly higher frequency (0.54). The results suggest a significant association between the interaction between genotype (C/C) and sex, and asymmetry of gray matter volume in the inferior frontal gyrus (F(1,2)= 9.240, P=0.010).

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Schistosoma haematobium, but not *Schistosoma mansoni*, increases urine specific gravity in a sample of rural Tanzanian women, 2016

ASHER Y. ROSINGER[1], SERA L. YOUNG[2], SHALEAN M. COLLINS[2], SYEDA R. HAIDER[3], PALLAVI MISHRA[3], HONEST T. NAGAI[4], MNYESHI PETRO[4], GODFRED O. BOATENG[2] and JENNIFER A. DOWNS[3]

[1]Department of Biobehavioral Health, Department of Anthropology, Pennsylvania State University, [2]Department of Anthropology, Northwestern University, [3]Department of Medicine, Center for Global Health, Weill Cornell Medicine, [4]National Institute for Medical Research, Mwanza Tanzania

Schistosomiasis is a neglected tropical parasitic infection that affects over 200 million humans worldwide and can damage central nervous, gastrointestinal, pulmonary, and renal systems. Schistosoma ova can be shed in urine (*S. haematobium)* or feces *(S. mansoni)*, respectively. Chronic filtration of waste, which elevates urine concentration, can cause kidney damage. However, little research has examined how different species of schistosomiasis affect urine specific gravity (USG), a biomarker of hydration and urine concentration. Therefore, we tested the relationship between *S. mansoni*- and *S. haematobium*-infected women and non-infected women and USG using urine and stool samples from 211 nonpregnant women living in rural northwest Tanzania. *S. haematobium* eggs were detected using the urine filtration method. *S. mansoni* eggs were detected using the Kato Katz method. USG was measured using a refractometer. Multiple linear and logistic regressions models of USG were built controlling for age, temperature, humidity, lactation, past treatment, and education. The prevalence of *S. haematobium* was 6.7% (95% CI: 3.3-10.1) and the prevalence of *S. mansoni* was 5.5% (95% CI: 2.3-8.6); the rest were uninfected. In multivariate models, *S. haematobium*-infected women had significantly higher USG (B=0.0044 g/ml; SE=0.0015; p=0.004) and odds (OR: 4.9, 95% CI: 1.34-17.83) of elevated USG (>1.020) than non-infected women, whereas *S. mansoni*-infected women (B=-0.0002 g/ml, SE=0.0025, p=0.95) did not. Future work should determine whether findings are attributable to parasite-induced debris in urine or urinary tract pathologies and early signs of renal damage. Human and non-human primate studies using USG in schistosome-endemic areas should account for schistosome-infection status.

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Determinants of variation in primate jaw kinematics

CALLUM F. ROSS[1], MYRA F. LAIRD[1], MICHAEL C. GRANATOSKY[1], JOSE IRIARTE-DIAZ[2], DAVID REED[2] and PAUL O'HIGGINS[3]

[1]Organismal Biology & Anatomy, University of

Chicago, [2]Department of Oral Biology, University of Illinois at Chicago, [3]Centre for Anatomical and Human Sciences, Hull York Medical School

In a seminal 1973 paper, Hiiemae and Kay suggested that morphological changes to the jaws and teeth have occurred within the limits of a pre-existing behavioral or kinematic temporal framework. But does morphological variation in the jaws and teeth impact jaw kinematics? We examined covariation between chewing cycle form and facial form by examining relationships between cranial variation and 3D jaw movements in three species of primates with diverse cranial morphology—*Macaca mulatta*, *Papio anubis*, and *Sapajus apella*. Three-dimensional movements of reflective markers coupled to mandible and cranium were captured at 250 Hz using a Vicon motion capture system and geometric morphometrics were used to test for covariation between 3D chewing jaw movements and facial form. Chewing cycles were standardized to 99 point motion clouds, registered to a common facial form, and the three-dimensional residual motion sequences were compared to facial variation of each species using a two-block partial least squares analysis. The results indicate significant covariation between gape cycle form and facial form, such that gape cycle size and shape covary with prognathism and mandibular form. We suggest that craniofacial morphology significantly influences the three-dimensional shape of jaw movements during chewing, but these effects on overall gape trajectory size and shape do not alter the basic pattern of primate jaw movement.

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Nutrient balancing in coexisting colobines

JESSICA M. ROTHMAN[1,2], COLIN A. CHAPMAN[3,4] and DAVID RAUBENHEIMER[5,6]

[1]Department of Anthropology, Hunter College of the City University of New York, [2]New York Consortium in Evolutionary Primatology, [3]Department of Anthropology and McGill School of Environment, McGill University, [4]Wildlife Conservation Society, [5]School of Life and Environmental Sciences, University of Sydney, [6]Charles Perkins Centre, University of Sydney

Many primates live with others in communities and niche separation allows for coexistence. To understand the nutritional factors that promote niche divergence, we studied two sympatric colobines in Kibale National Park, Uganda. The diets of these two colobus monkeys, the red colobus (*Procolobus rufomitratus*) and the black-and-white colobus (*Colobus guereza*), have been well studied in this habitat over several decades. Both species have a diet comprised almost entirely of young leaves (>85%), and dietary overlap varies from 50-76%. To decipher their nutritional strategies, we estimated nutrient intake of both red colobus and black-and-white colobus females by conducting all-day focal follows (n=50 for each species), collecting foods eaten, and analyzing these foods for their nutritional composition. Red colobus females ate ~15 foods per day, while black-and-white colobus ate ~6 foods a day. Sometimes black-and-white colobus ate just one species of young leaves in a day (~16% of observations). Using generalized mixed models we found that the mean daily dietary ratios of non-protein energy to available protein consumed by the two colobines were different (red colobus 2:1, black-and-white colobus 1:1, $p<0.01$). Non-protein energy in both colobine diets was obtained through non-structural carbohydrates and digestible fiber, and both consumed very little fat (<2% of dry matter). Compared to published data on frugivorous primates, both species of colobines ate diets that were much higher in protein, and lower in digestible carbohydrates. Our results demonstrate that these two colobus monkeys eat similar foods, but eat them in different amounts, and balance macronutrients in disparate ways.

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Arthritis in Rhesus macaques (*Macaca mulatta*) from Cayo Santiago

BRUCE M. ROTHSCHILD[1], QIAN WANG[2], JEAN E. TURNQUIST[3,4], C. JEAN. DEROUSSEAU[3,5], MATTHEW J. KESSLER[6] and KENNETH P.H. PRITZKER[1,7]

[1]Department of Medicine, West Virginia University School of Medicine, [2]Department of Biomedical Sciences, Texas A&M University College of Dentistry, [3]Caribbean Primate Research Center, University of Puerto Rico Medical Sciences Campus, [4]Department of Anatomy and Neurobiology, University of Puerto Rico School of Medicine, [5]Department of Anthropology, New York University, [6]Office of Laboratory Animal Resources, West Virginia University Robert C. Byrd Health Sciences Center, [7]Department of Laboratory Medicine and Pathobiology, University of Toronto

Arthritis is one of most common age-related conditions in humans leading to an increased risk of fracture or immobility. Although the symptoms may be managed, its causes and the ability to prevent it remain elusive. Rhesus macaque's skeletal system is similar to that of humans, and also display similar osteopathologies found in humans. In this study, the skeletons of 275 Rhesus macaques from Cayo Santiago were surveyed for arthritis. Results demonstrated that there were three different kinds of arthritis, including osteoarthritis, spondyloarthropathy, and calcium pyrophosphate deposition disease (CPPD), in which osteoarthritis was recognized through the signs of peripheral joint osteophytes; CPPD was characterized by subchondral joint surface deposition and plate-like overgrowths; and spondyloarthropathy was characterized by syndesmophytes, peripheral and axial joint subchondral erosions, reactive new bone formation and joint fusion. All three disorders were each present in approximately 20% in this sample. Comparison of naturally occurring spondyloarthropathy in Rhesus macaques with the disease produced by collagen injection and with the spondyloarthropathy observed in humans revealed that the macaque and human manifestations were indistinguishable, whereas the collagen model of disease was different, affecting 70% of those injected, producing a predominantly polyarticular pattern of spondyloarthropathy. The presence of Spondyloarthroapthy and CPPD, two forms of inflammatory arthritis in Cayo Santiago samples were for the first time revealed in a Rhesus macaque population as a non-human primate species, permitting characterization of the nature of these conditions in macaque models for greater understanding and for managing and/or curing these diseases in humans and macaques.

Quantitative methods for identification of bone surface modifications

CAROLINE E. ROWE

Anthropology, University of Minnesota-Twin Cities

Bone surface modifications are frequently the only direct evidence available when reconstructing behaviors and activities at modern forensic, archaeological and paleontological sites, making their accurate identification even more critical for developing models of carcass acquisition. This is especially true at archaeologically significant sites, such as Olduvai Gorge, Tanzania where the hunting/scavenging debate has not only loomed for decades but has relied on bone surface modification morphology to identify the involvement of carnivores and hominins. Replacing subjective, qualitative assessment of modification morphology with objective, quantitative methods would aid in the reduction of modification ambiguity and produce less contentious results.

This research uses software analysis of visible light microscopic images to quantitatively characterize known bone surface modifications. Data from the x, y and z plane show differences in modification contour, shape, depth and surface roughness that are consistent and distinguishable among carnivore teeth, microbes and stone tools. The use of quantifiable data is especially critical for establishing accurate identification of modifications that can resolve issues regarding the order of carcass acquisition at sites such as Olduvai Gorge, Tanzania.

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Great ape thorax and shoulder – adapted for arboreality or knuckle-walking?

DANIELLE RUBINSTEIN[1], SUSAN G. LARSON[2] and NATHAN E. THOMPSON[1]

[1]Department of Anatomy, NYIT College of Osteopathic Medicine, [2]Department of Anatomical Sciences, Stony Brook University Medicine

Great apes possess a constricted upper thorax and cranially positioned scapula, which have long been related to adaptations for arboreality. Recently, it has been proposed that these morphologies are adaptations for knuckle-walking in apes with dorsally positioned scapulae. Under this hypothesis, it is assumed that knuckle-walking entails high amounts of scapular cranial translation and protraction, and large impact transient forces at touchdown that entail an altered position (and potentially function) of *m. serratus anterior*. Here we test these predictions using kinematic, kinetic, and electromyographic (EMG) data from chimpanzees walking quadrupedally and vertically climbing, with comparisons to similar data in quadrupedal monkeys.

Chimpanzee data (n = 2 subjects) were recorded using a four-camera Xcitex motion capture system and four AMTI force plates, and EMG data for the cranial *m. serratus anterior* were collected via indwelling electrodes.

Contrary to the predictions outlined above, we found that the scapula is consistently more cranially positioned (relative to the vertebral column) during vertical climbing (5.1 ± 2.1 cm) compared to quadrupedalism (0.2 ± 1.3 cm; n = 10 strides per gait). Muscle activity in serratus anterior was no different than quadrupedal activity in other primates. Further, relative to body mass (BM), peak ground reaction force loading rates were similar, or slightly lower, in chimpanzees than in quadrupedal rhesus macaques (6.9 ± 2.2 BM/s versus 19.7 ± 5.4 BM/s). Together these results show little-to-no support for the hypothesis that upper thorax and scapular configuration are specifically linked to the mechanics of knuckle-walking.

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Handedness-related asymmetries in modern human brains: implications for paleoneurology

LANA M. RUCK[1,2] and P. THOMAS SCHOENEMANN[1,2]

[1]Cognitive Science Program, Indiana University, [2]Department of Anthropology, Indiana University

Handedness has long been a topic of interest in paleoanthropology due to its unique distribution in the hominin lineage and its association with other behaviors, such as tool making and language. Research into the origins and evolution of right-hand predominance include work on skeletal asymmetry, evidence in lithics, and evidence from endocasts. We assessed handedness-related asymmetry in modern human brains using anatomical MRI scans of 42 subjects (21 strong left-handers; 21 strong right-handers, matched for age and sex) from the Human Connectome Project.

To compare overall structural differences in the brain, a "template brain" was first created using non-rigid morphing techniques (Advanced Normalization Tools software). This represents the average brain morhpology for the study sample. Voxel-wise scaling coefficients (Jacobians) were then calculated. These describe the localized size differences between each subject and the template. T-tests were then performed on the log Jacobians at each voxel, assessing the differences between left- and right-handers' brains. Correlations between Jacobians and Edinburgh Handedness Inventory scores were also calculated at each voxel. The resulting global statistical maps highlight differences in anatomy between left- and right-handers. Although these values did not survive conservative FDR correction, the areas which differ most between left- and right-handers in this sample are in expected brain regions, including the hand motor cortex, language- and tool-associated areas, and regions associated with petalias.

Our results provide additional incentives for researchers to continue exploring methodologies for identifying handedness in the fossil record, and have implications for assessing individual handedness from preserved endocasts as well.

Y-Chromosome Introgression: An Analysis of Spermatogenesis Genes Between *Macaca mulatta* and *Macaca fascicularis*

CODY A. RUIZ and ANTHONY J. TOSI

Anthropology, Kent State University

Macaque monkeys live in multimale-multifemale social groups with males exhibiting some of the largest testis:body weight ratios among primates. As such, they are believed to experience intense levels of sperm competition. Several spermatogenesis genes are located on the Y-chromosome and, interestingly, occasional hybridization has led to the introgression of the rhesus macaque (*Macaca mulatta*) Y-chromosome deep into the range of the cynomolgus macaque (*Macaca fascicularis*). These observations have led to the hypothesis that the successful introgression of the rhesus Y-haplotype is due to selectively advantageous functional differences in sperm genes compared to those of the native cynomolgus Y-haplotype. The hypothesis is examined here at four Y-chromosomal genes: *RBMY*, *XKRY*, and two copies of *CDY*. The genes were surveyed in representative animals from north of, south of, and within the rhesus-cynomolgus introgression zone. Amino acid differences were uncovered in some genes; however, the McDonald-Kreitman test did not detect a definite signal of positive selection. Yet, because these amino acid differences yield distinct protein-folding predicted structures, they may indeed present selective advantages to the rhesus Y-haplotype. Implications of these results are discussed, as are directions for future study.

Comparison of callitrichid limb bone properties to those of cheirogaleids and arboreal sciurids

JACQUELINE RUNESTAD CONNOUR

Biological Sciences, Ohio Northern University

Callitrichid limb bone biomechanical properties are compared to those of cheirogaleids and arboreal sciurids to explore whether callitrichid claws result in greater similarity to sciurids than to cheirogaleids. It was expected that the ability of callitrichids and sciurids to cling to large surfaces and jump to noncompliant supports would result in thicker bone cortices. Results partially support expectations.

Limb bone properties analyzed include humeral and femoral midshaft cortical areas and lengths obtained from X-rays. Log-transformed species averages for these properties and body mass were calculated and regressed on each other. ANCOVA was used to compare slopes and elevations of these regressions. Additional comparisons between sciurids and an *Aotus*/*Saimiri* data set were performed. Keel-nailed cheirogaleid *Phaner furcifer* was kept separate.

Results indicate sciurids are greater in humeral cortical area relative to body mass than cheirogaleids. Callitrichids plot in between the other groups, and don't differ significantly from either. For humeral cortical area relative to femoral cortical area, sciurid and callitrichid regressions lie on top of each other, and differ significantly from cheirogaleids and the *Aotus*/*Saimiri* sample. Comparisons of femoral cortical area regressed on body mass show no differences.

From these results, callitrichids appear to have thicker humeral cortices than expected for primates, somewhat like sciurids. This may be caused by clinging to trunks with claws and large landing impacts. Femoral cortical area may be similar for all groups because all are adept jumpers. Adding more callitrichid species may clarify results as this group is behaviorally variable.

Facial fluctuating asymmetry as a marker of cumulative health burden in women

KATE RUSK, CARMEN MOSLEY, KEITH HUNLEY, MEGHAN HEALY and HEATHER J.H. EDGAR

Anthropology, University of New Mexico

This study assesses the relationship between facial fluctuating asymmetry and allostatic

load, a measure of cumulative health burden. The study sample is comprised of 313 male and female New Mexicans of Spanish-speaking descent. Data include 12 three-dimensional facial landmarks, a series of 10 health outcomes and markers of health risk, and several demographic and sociocultural measures for each individual. Individual fluctuating asymmetry values were calculated using a two-factor Procrustes ANOVA in MorphoJ. Allostatic load was calculated as the total number of health measures identified as high risk for each individual. We used one-tailed t-tests, across the entire sample and within individual age groups, to test the hypothesis that facial fluctuating asymmetry is statistically significantly higher in individuals with high allostatic load.

Across all ages and sexes, we found a statistically significant increase in fluctuating asymmetry in the high allostatic load group ($p < .05$). Within individual age groups, this statistically significant increase was only found in the middle ages, ranging from 35 to 64 years ($p < .01$). We found fluctuating asymmetry is significantly increased in high allostatic load females, but not in males. This increase in asymmetry in females was similarly found in the entire sample and middle age range only ($p < .005$ in both). These results provide evidence that facial fluctuating asymmetry represents an informative marker of health risk in middle and later life in women, although perhaps not in men.

Proportions of the lateral tibial condyle and posterior meniscal notch size in *Homo sapiens*

C. KINLEY RUSSELL

Anthropology, New York University, Center for Functional Anatomy & Evolution, Johns Hopkins University School of Medicine

It has been argued that among hominoids, lateral meniscus shape is determined by the length of the lateral femoral and tibial condyles. Under such a scenario, the human crescent-shaped lateral meniscus, with two meniscotibial insertions, is the developmental byproduct of the elongation of the bony components of the lateral knee compartment. However, some humans lack the posterior lateral meniscal insertion and/or its bony indicator, the meniscal notch. Here I examine the relationship between the shape of the lateral tibial condyle and meniscal notch size in modern humans.

Photographs were taken of 350 modern human (137 female, 209 male) proximal tibiae curated by the American Museum of Natural History. Individuals were selected to span a wide range of body sizes. Linear dimensions and areas of features of the proximal tibia were collected in ImageJ. Meniscal notch area was compared to three lateral tibial condyle length proportions: ratio of medial and lateral condyle lengths, lateral condyle length and mediolateral tibial breadth, and length and width of the lateral condyle.

No significant relationship was found between any of the lateral tibial condyle proportions and meniscal notch area. These results suggest that variation in the insertion anatomy of the lateral meniscus cannot be clearly related to tibial articular proportions in modern humans, and may challenge its developmental origin. Interestingly, females were found to have significantly longer lateral condyles compared to mediolateral tibial breadth than males ($p=0.004$). Biological sex may significantly impact condylar proportions, which has implications for the reconstruction of fossil hominin locomotor behavior.

Howler Monkey and Leafcutter Ant Resource Competition: A Widely-Known but Little-Tested Hypothesis

DORIAN G. RUSSELL

Department of Environmental Science, American University

Theoretical predictions on ecological resource competition between mantled howler monkeys (*Alouatta palliata*) and leafcutter ants (*Atta* spp. and *Acromyrex spp.*) have been suggested because both groups share geographic habitat and a generalist foraging pattern with preference for young leaves. Observational studies evaluating these predictions are nearly nonexistent, with one study comparing previously-collected howler and leafcutter foraging datasets obtained separately for other research objectives. The present study incorporated time as a variable and focused on simultaneous resource use between the potential competitors in tandem with botanic identification of mutually-used resources. Focal animal point sampling techniques were used to identify howler monkey feeding trees, which were inspected for leafcutter ant activity.

Mutually-used howler monkey and leafcutter foraging trees were identified at the La Suerte Biological Field Station's tropical moist forest in Costa Rica from June to August 2017 using a rotational transect survey system. Twenty-nine howler monkey feeding trees were identified and surveyed for leafcutter foraging activity simultaneous with howler feeding activities. Seven of 29 (24.14%) had simultaneous activity. While both howlers and leaf-cutter ants will forage for plant and flower material, 100% of mutual foraging trees were only used for leaf foraging by both groups. Seven out of 29 (24.14%) howler feeding trees were in the genus *Ficus*. Of the 7 trees also used by leaf-cutter ants, 4 (57.14%) were in the *Ficus* genus. *Ficus* trees are a preferred resource for howler monkeys and my findings suggest shared feeding preferences may position mantled howler monkeys and leafcutter ants as ecological competitors.

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Foramen magnum position and angle reflect neural organization

AIDAN A. RUTH[1], MARY ANN RAGHANTI[2] and C. OWEN LOVEJOY[2]

[1]Pathology and Anatomical Sciences, University of Missouri, [2]Anthropology, Kent State University

An anteriorinferior position of the foramen magnum (FM) distinguishes humans from other hominoids. However, the significance of this morphology is still debated. We analyzed FM position (FMP) and FM angle (FMA) in relation to relative brain size in marsupials (N=19), rodents (N=12), and Pteropodid bats (n=19), as well as in relation to cortical volume (CV) in bats. In order to isolate FMP from the effects of masticatory size, we used the length of the occipital-sphenoid complex divided by the cube root of body mass to represent FMP. FMA was measured as the angle of the basion-opisthion plane relative to the Frankfort Horizontal. Brain and body weights, non-cortical volume (NCV) and CV were taken from the literature and their cube roots used to normalize our linear craniometrics. In all groups, FMP lies more posterior relative to brain size, which reflects the scaling of non-cortical brain regions lying adjacent to the basicranium (Marsupials: $r=0.862$, $p<0.001$; Rodents: $r=0.628$, $p<0.05$; Bats: $r=0.574$, $p<0.01$). In bats, FMP moves posteriorly with an increase in NCV ($r=0.698$, $p= 0.001$), but anteriorly with greater CV ($r=-0.616$, $p<0.005$); that is, the greater the CV of a species, the shorter its basicranial length. There is also an association between CV and FMA ($r=0.478$, $p=0.026$), such that as CV increases, the FM lies more anteriorly. These results show that increases in cortical volume drive the evolution of shortened, flexed basicrania in multiple taxa and suggest that neural reorganization is the primary driver of the anterioinferior FM shift in humans.

From Start to End: Maternal early life conditions, perinatal mortality, and the limits of personal responsibility across pregnancy

JULIENNE RUTHERFORD

Women, Children, and Family Health Science, University of Illinois at Chicago

The tragic perinatal loss of an infant is often framed either explicitly or implicitly as resulting from choices a mother made during pregnancy. These losses impact human populations differentially: the U.S. perinatal mortality rate is more than twice as high for Black women as for White women. Rates of low birth weight and obesity are similarly distributed. Current models of perinatal loss focus on a woman's adult health, behaviors,

and socioeconomic status; such models leave many losses unexplained, and don't address foundational sociopolitical causes of disparities. I argue that the end of a pregnancy is shaped in large part by the start of a woman's own life, even while she herself is still a fetus, and that adult disparities emerge from early life disparities. I will present ongoing research from a litter-bearing primate, the marmoset monkey in support of this womb to womb paradigm. Our NIH-funded intergenerational study has shown that a marmoset mother who is obese early in pregnancy experiences a ~400% increase in stillbirths, and a mother who is herself born with a phenotype associated with fetal growth disruption experiences a ~250% increase in neonatal deaths. Since adult obesity is often preceded by pediatric obesity, together our research suggests that at least some pregnancy complications are linked to a mother's own fetal and juvenile development. These early life precursors of adult reproductive success are themselves potentially anchored in transgenerational processes of societal origin rather than individual responsibilities, and thus modifiable by societal, rather than individual, solutions.

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Sphenoidal Sinuses and Spatial Compromise in Basicranial Modular Development and Evolution

KATHARINE G.J. RYAN[1], JAY T. STOCK[2] and LAURA T. BUCK[2]

[1]Department of Anthropology, University of Tennessee, Knoxville, [2]Department of Archaeology and Anthropology, University of Cambridge

Modularity is critical to the formation of complex biological structures, enabling greater evolvability and mosaic evolution. The zone of accommodation (ZoA) hypothesis posits that the maxillary sinuses in modern humans provide spatial compromise for the adjacent skeletal elements of the midface, thus facilitating greater modularity in the facial skeleton. The current study investigated whether the ZoA hypothesis is applicable to the sphenoidal sinuses, which are centrally located in the basicranium, at the intersection of the cranial fossae and adjacent to the synchondroses, where cranial base angulation occurs. It was hypothesized that sphenoidal sinuses accommodate the modularity of the cranial fossae, in which case sphenoidal sinus volume would explain a significant amount of variation of the fossae shapes and the angulation between them, while the cranial fossae would be modular relative to each other. A sample (N=45) of CT scans of adult human crania were digitized and their sphenoidal sinuses sectioned out. Geometric morphometric analyses were used to analyze endocranial shape. The results partially support the hypothesis, showing significant modularity between the shapes of the fossae and significant correlations between the sphenoidal sinus volumes, the morphology of the anterior cranial fossa (ACF), and several angles of the midline basicranium. This suggests that the sphenoidal sinuses may spatially accommodate variation in the ACF, while the hypothesis that it accommodates the entire basicranium was rejected. Because the ACF contributes to the posterior face, this relationship may have important implications in the growth and modularity of the face and basicranium.

Orientation of trabecular bone in the femoral head reflects human-like hip joint loading in fossil hominins

TIMOTHY M. RYAN[1,2], KRISTIAN J. CARLSON[3,4], ADAM D. GORDON[5], NINA JABLONSKI[1], COLIN N. SHAW[6] and JAY T. STOCK[6,7]

[1]Department of Anthropology, Pennsylvania State University, [2]Center for Quantitative Imaging, Pennsylvania State University, [3]Department of Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [4]Evolutionary Studies Institute, University of the Witwatersrand, [5]Department of Anthropology, University at Albany - SUNY, [6]PAVE Research Group, Department of Archaeology, University of Cambridge, [7]Department of Anthropology, Western University

Skeletal attributes indicative of habitual bipedal locomotion are present in the earliest recognized hominins. However, debate persists about bipedal locomotor behavior in fossil hominins, including the nature of gait kinematics, locomotor variability across different species and the degree to which various australopith species engaged in arboreal behaviors. In this study, we analyze variation in trabecular bone structure from the femoral head using a sample of modern humans, extant hominoids, baboons, and fossil hominins attributed to *Australopithecus africanus*, *Paranthropus robustus*, and the genus *Homo*. We use microCT data to characterize the fabric anisotropy, material orientation, and bone volume fraction of trabecular bone to reconstruct hip joint kinematics in these groups. We show that trabecular bone fabric structure in the femoral heads of australopiths is more similar to that of modern humans and Pleistocene *Homo* than non-human hominoids, indicating that these australopiths walked with human-like hip kinematics, including an extended hip and a more limited range of habitual hip joint postures during bipedalism. Results also indicate that australopiths have robust femoral head trabecular bone, suggesting elevated loading of the musculoskeletal system above modern human levels, and comparable to those of extant apes. These results provide new evidence of human-like bipedal locomotor kinematics in Pliocene hominins, even while other aspects of their musculoskeletal systems retain adaptations to other locomotor strategies.

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Monitoring diagenesis of enamel in East African fossil fauna and implications for inferring trophic level from trace element analysis

CHRISTINA M. RYDER[1], RHONDA L. QUINN[2,3] and JASON LEWIS[4,5]

[1]Department of Anthropology, University of Colorado at Boulder, [2]Department of Sociology, Anthropology & Social Work, Seton Hall University, [3]Department of Earth and Planetary Sciences, Rutgers University, [4]Department of Anthropology, Stony Brook University, [5]Turkana Basin Institute

Trace element analysis of Sr/Ca, Ba/Ca, and Mg/Ca successfully differentiated trophic level among extant mammalian taxa from Laikipia, Kenya. Before application to enamel of fossil hominins, the uptake of these elements in fossil fauna should be known. Concomitantly, the effects of diagenesis on trace elements in the enamel of fossil fauna require investigation. Mn, Zn, Rb, Y, La, Sm, Yb, Th, and U are select trace elements that are hypothesized to be at the sub-p.p.b. ion level in unmodified tissue; thus monitoring concentrations of each of these elements in fossil fauna is used to test for diagenesis. A common pretreatment of fossil enamel to remove diagenetic carbonate involves a short timed reaction with a weak acetic acid. Here we analyze the nine diagenetic elements listed above in the enamel of 86 fossil fauna from Turkana Basin of Kenya. Of the 86 samples analyzed, 45 received no acetic acid pretreatment, and 41 samples were treated with 0.1 N acetic acid for 10 minutes. We found no statistical differences between the pretreated and unpretreated fossil enamel samples for each of the nine diagenetic elements. These results do not support the utility of an acetic acid pretreatment for trace element analysis of fossil enamel. Some but not all diagenetic elements increased in concentration from modern to fossil contexts. We interpret that this Turkana fossil enamel sample has undergone element-specific diagenetic effects, but still holds promise for trace element analysis for inferring trophic level.

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Immature male chimpanzees at Kanyawara receive higher rates of aggression compared to females

KRIS H. SABBI[1], MELISSA EMERY THOMPSON[1], ZARIN P. MACHANDA[2], RICHARD W. WRANGHAM[3] and MARTIN N. MULLER[1]

[1]Anthropology, University of New Mexico, [2]Anthropology, Tufts University, [3]Human Evolutionary Biology, Harvard University

Sex differences in aggression are pervasive in primates. In humans, one hypothesis is that increased aggression among men is socially learned and that boys are trained into more aggressive roles from early development (Tremblay 2000). This hypothesis is difficult to test in human subjects, thus most of the literature concerns abuse and traumatic violence rather than more moderate or typical exposure of normal development. Chimpanzees provide an excellent comparative naturalistic framework for investigating experiential effects on developing aggressive behavioral strategies because of their long juvenile periods and extreme sexual dimorphism in aggression among adults. In this study, we used GLMM to evaluate how age and sex contributed to aggression received by immature wild chimpanzees (<9 years old, N = 23) over 10 years of study in the Kanyawara community of Kibale National Park, Uganda. Males received 62.9% (N = 4005) of 6367 recorded aggressive events against immatures. Aggression received increased with age (β(age)=0.0045, $p<0.001$) and this increase was steeper among males compared to females (β(age*sex)=0.0019, $p=0.002$), with a sex difference beginning to emerge around 6 years. When immature males were victims, it came from adult males nearly half of the time (42.2%), whereas female victims received 25.6% of aggression from adults males. Together, this indicates that young males may become more vulnerable to adult male aggression shortly after weaning, but before undergoing pubertal development. Our data suggest the possibility that increased exposure to aggression during development could be one mechanism contributing to higher use of aggression by adult males.

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Linking calcaneal trabecular bone ontogeny and the development of bipedal human gait

JAAP PP. SAERS[1], COLIN N. SHAW[1], TIMOTHY M. RYAN[2,3] and JAY T. STOCK[1]

[1]Department of Biological Anthropology, University of Cambridge, [2]Department of Anthropology, Pennsylvania State University, [3]Center for Quantitative Imaging, EMS Energy Institute, Pennsylvania State University

Trabecular bone structure in adulthood is a product of a process of modelling during ontogeny and remodelling throughout life. Understanding ontogeny is essential to understand the functional significance of trabecular bone structural variation in adults. The complex shape and loading of the human calcaneus provides a natural experiment to test the relationship between trabecular morphology and locomotor development. We investigate the relationship between calcaneal trabecular bone structure and changes in loading related to development of gait and body size in growing children.

We sample three main trabecular regions in 35 individuals aged between neonate to adult from Norris Farms (1300 AD, USA) and Cambridge (1200-1500AD, UK). Trabecular properties are calculated in volumes of interest placed beneath the calcaneocuboid joint, plantar ligaments, and posterior talar facet.

At birth, thin trabecular struts are arranged in a dense isotropic structure. Bone volume fraction strongly reduces in the first year of life while anisotropy and mean trabecular thickness increase. Dorsal compressive trabecular bands appear at the onset of bipedal walking, and plantar tensile bands develop in concert with propulsive toe-off. Bone volume fraction and anisotropy increase until the age of 8 when gait has largely matured, while trabeculae gradually thicken until adulthood.

This study demonstrates that three different regions of the calcaneus develop into distinct adult morphologies through varying developmental trajectories. These results suggest a strong relationship between the mechanical environment and trabecular bone architecture in the human calcaneus during growth.

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Adaptive evolution of complex haplotypes harboring the metabolizing the *GSTM1* gene deletion

MARIE SAITOU[1,2], TAKAFUMI ISHIDA[1], YOKO SATTA[3] and OMER GOKCUMEN[2]

[1]Dept. of Biological Sciences, The University of Tokyo, [2]Dept. of Biological Sciences, State University of New York at Buffalo, [3]Dept. of Biosystems Science, The Graduate University for Advanced Studies (SOKENDAI)

Structural variants, such as copy number variation of genes, have been increasingly recognized in anthropological genetics as significant drivers of human phenotypic diversity. Indeed, several common copy number variants have been associated with diet and metabolism, which is a core area of discussion in human evolutionary studies. We have now conducted a genome-wide analysis to show that deletions of two metabolizing genes, the UGT2b17 and the GSTM1, are polymorphic both in humans and chimpanzees, suggesting the presence of convergent evolutionary pressures. Here, we present our analysis of 2,504 human genomes to determine the evolutionary history of the deletion of the GSTM1, which is one of the most frequent structural variants in human populations. Our analysis identifiedTanuki haplogroup, which carries the GSTM1 deletion and is found approximately 70% of East Asian chromosomes. This haplogroup has rapidly increased its frequency in East Asian populations contributing to a high populational differentiation between African and East Asian populations (FST>0.62). We showed that both the nucleotide diversity and population differentiation for this haplogroup is incompatible with simulated expectations in East Asian populations. In parallel, we revealed that the Tanuki haplogroup is significantly associated with the expression levels of other GSTM genes neighboring the GSTM1. Collectively, our results suggest that the Tanuki haplogroup, and the linked deletion of the GSTM1, has likely undergone a soft sweep in East Asian. This study adds to the emerging number of functional, structural variation that contributes to anthropologically relevant phenotypic variation in humans.

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Effects of captivity on cranial form in the Celebes crested macaque (*Macaca nigra*)

ADRIANA SALDAN[1], JOSEPH R. KRECIOCH[2] and MICHELLE SINGLETON[1,2]

[1]Chicago College of Osteopathic Medicine, [2]Department of Anatomy, Midwestern University

Multiple studies have demonstrated that crania of captive vertebrates differ in size and shape from those of wild conspecifics. Singleton (2012) suggested that the atypical morphology observed in crania of captive *Mandrillus* males is due to an extension of normal development (peramorphosis) under conditions of captivity. This study applies geometric morphometric analysis to characterize cranial form differences between captive and wild crania of a similar papionin species, the Celebes crested macaque (*Macaca nigra),* and tests the hypothesis that peramorphosis contributes to cranial form differences in captive primates.

The sample comprised 46 *M. nigra* crania: a mixed-sex ontogenetic series of 38 wild specimens and 8 captive adults. Three-dimensional landmarks/semilandmarks (127/23) were placed on digital models using *Landmark* v. 3.6. Following generalized Procrustes analysis with semilandmark sliding, size and shape differences were examined using centroid size, PCA, ANOVA of PC

scores, and multivariate regression. Regression scores calculated from the wild-type ontogenetic regression were used to compare captive crania to the normal developmental trajectory.

Captive crania are larger than wild-type crania, and this difference is significant in males (p = 0.004). Adult PC2 scores mostly separate captive and wild specimens (ANOVA p = 0.0004). Captives, especially males, exhibit greater airorhynchy, dorsal rotation of the premaxilla, and more prominent browridges. Male captives fall in line with but beyond the wild size-shape trajectory; captive females overlap the wild female distribution. Results are consistent with male peramorphosis and suggest that the differential effects of captivity on male versus female primates merit further research.

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Time and energy budgets and food requirements of the crop raiding Barbary macaques *Macaca sylvanus* in the High Ourika valley, western High Atlas range, Morocco

NAMOUS SALWA and ZNARI MOHAMMED

Department of Biology, Cadi Ayyad University , Marrakesh

There are few studies that provide data about food supply and demand in nature, partly because of difficulties in measuring food requirements in free-ranging animals. In Primates, the time-energy budget method is still mostly used because of its cheapness and non-invasiveness compared to the doubly labeled water method. It can be very useful in estimating daily food consumption in crop raiding primates in order to assess the importance of crop damages. In this regard, we estimated the total energy expenditure and food consumption in a crop-raiding troop of Barbary macaques in High Ourika valley, western High Atlas, Morocco, during the fruiting season in spring-summer 2012 from time-activity data and using Coelho's energetic model. The studied troop comprised 46 individuals including 25 adults, 6 juveniles and 15 infants. Total energy expenditure averaged 433 kJ.kg-1. day-1, and feeding rate was estimated to ~28 g dry matter kg-1.day-1, or 79g fresh matter kg-1. day-1. Given that 40% of the diet is composed of cultivated fruits, the total crop raided fruits by the whole troop was estimated to 23kg fresh matter per day, which would correspond to more than 4 tons of fruits during the whole 6-month fruiting season. These estimates would be very helpful in the farmer-macaque conflict management in the High Ourika valley.

Evaluating the self-domestication hypothesis of human evolution

MARCELO R. SÁNCHEZ-VILLAGRA[1] and CAREL P. VAN SCHAIK[2]

[1]Paleontology, University of Zurich, [2]Anthropology, University of Zurich

Early XXth century studies posited how the very traits that are so variable in humans are precisely those recorded as highly variable among domesticated species subject of intense selective breeding, as in dog breeds. The current version of the self-domestication hypothesis posits that the effects of selection against aggression in morphology, physiology, behavior and psychology reported for domestic animals operated in human evolution too. This hypothesis attempts to explain the behavioral and morphological changes in human evolution from the Middle Pleistocene to recent times, in particular, our reduced aggressiveness and the shortening of the upper facial skeleton and a reduction in brow ridge projection: these changes are tied to physiological changes connected to the rise of high levels of social tolerance and its cognitive consequences. Unfortunately, the self-domestication hypothesis cannot easily be reconciled with the complex and multivariate empirical record of morphological features of humans. Its full evaluation requires (1) data on rate and variation in human evolution (currently lacking); (2) specification of the time window (if the Holocene is included, the confounding effects of agriculture and sedentary life must be removed); (3) a complete test of the neural crest mechanisms that would be associated with the coupling of traits in domestication (hardly testable for mammals, and although testable in chickens using developmental genetics tools, this model may not be applicable to a primate, because clades of tetrapods vary in the relation between neural crest development and adult morphology).

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Insights into the primitive brain of primates: Treeshrew cranial endocasts and geometric morphometrics analysis

GABRIELA SAN MARTIN FLORES, LAVANIA NAGENDRAN and MARY SILCOX

Anthropology, University of Toronto

Establishing what is primitive for Primates for the form of the brain requires an understanding of its morphology in primates' closest living relatives: Dermoptera and Scandentia (treeshrews). As larger animals, dermopterans have gyrencephalic brains, making them problematic as models for the form of the brain in smaller ancestral primates. Treeshrews, on the other hand, have often been used as a proxy for the ancestor of primates because they are small-bodied and have smaller, lissencephalic brains. However, previous studies have generally been restricted in their taxonomic range, particularly excluding *Ptilocercus lowii*, which is the most primitive living treeshrew.

This study uses Geometric Morphometrics on the endocasts of a diversity of living treeshrews in order to better characterize the variation in their morphology, and to create a context to compare them to early primate endocasts. A new set of 21 endocranial landmarks were placed on endocasts derived from microCT data for three treeshrew genera: *Ptilocercus* (n=5), *Tupaia* (n=9), and *Dendrogale* (n=2). Two plesiadapiforms were also landmarked: *Ignacius graybullianus* (n=1) and *Microsyops annectens* (n=1). The coordinate data were used in a Principal Components Analysis. The results of that analysis show that there is a lot of variation among the treeshrews, with two distinct groups: one largely composed of tupaiine treeshrews and the other including all the specimens of *Ptilocercus*. In spite of sharing superficial similarities, the treeshrews did not group with the plesiadapiforms, which suggests that members of Scandentia share features that have evolved since their common ancestor with Primates.

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Craniotomy and thoracotomy in the individuals from the Coimbra Identified Skeletal Collection (early 20th century, Portugal)

ANA LUISA SANTOS[1,2], DANIEL ALVES[1] and BRUNO M. MAGALHÃES[1,2]

[1]Department of Life Sciences, University of Coimbra, [2]Research Centre for Anthropology and Health (CIAS), University of Coimbra

Circumferential craniotomy (to examine the brain and other structures), and thoracotomy (to inspect the thoracic cage) are procedures used in postmortem examination of cadavers. These techniques are applied in autopsy (to determine the cause of death) and in anatomical dissection/prosection (for educational purposes). This study aims to investigate the cut marks observable in the skeletons of the Coimbra Identified Skeletal Collection (CISC), to determine the prevalence of craniotomies and thoracotomies, and to search the underlying reasons for its application. The 505 individuals of the CISC were macroscopic observed. The Coimbra University Hospital and Legal Medicine records, as well as the available teaching manuals, were searched. Thirty-nine individuals (39/505;7.7%) show evidence of postmortem medical procedures: three craniotomies (7.7%), twelve thoracotomies (30.8%) and twenty-four of both (61.5%), representing 14 females (35.9%) and 25 males (64.1%), without statistical significance between sexes (*Pearson* x^2=3.103; *d.f.*=1; *p*=0.078). Age at death ranges from 16 to 75 years old ($\bar{X}$=35.18), and they died

between 1915 and 1931. Twelve were autopsied after an accidental or violent death (e.g. homicide, poisoning). Moreover, unclaimed bodies of individuals who died in hospitals, nursing homes, and public care homes were available by law to dissection/prosection. At least a male individual was kept at the Anatomical Theater, having been buried 7 months after death. Uncommon conditions and/or disease processes (*e.g.* aspergillosis, amaurosis) may have resulted in dissection/prosection of seven individuals. This research provided new data about the CISC individuals, on legal issues related to autopsy, and on history and teaching of medicine.

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Increasing connectivity through artificial canopy bridge for the gibbons: a case study on the activity budget

CHANPEN SARALAMBA and WIKANDA MENPREEDA

Conservation Biology, Mahidol University

White-handed gibbon *(Hylobates lar)* is a small primate, which was categorized as endanger species by IUCN Red List. Gibbons always live their life on the canopy of forest. However some group of Khao Yai gibbons have been forced to walk across the road because their home range of gibbons are fragmented by Prachinburi Rd.- Khao Yai National Park Rd. Currently, the National Park has installed rope corridor as helping gibbons to cross on the air instead of cement road. So, this study was aim to study activity budget and daily path length of gibbons and how they use the rope to connect their home range. All behaviors were recorded every 5 min scan sampling and save routes foraging with GPS for 227 hours. From the results, diet affected to activity budget and daily path length. During July-August, gibbons increased travelling when fruit were more abundant. While, gibbons increased resting when they ate more leaves during December-February. Abundance of fruit indicated frequency of using corridor by gibbons. In rainy season, gibbons ate fruit 70.8% on average due to ripe fruit present both side of road. Therefore, corridor is important to make crossing in fragmented area easier. Gibbon can choose diet that is normally seasonal variation and reduce the risk of accident on the road.

Wildlife Conservation Society Thailand program

Physiology at the Final Frontier: The Role of Biological Anthropology in Human-Space Research

MALLIKA S. SARMA

Department of Anthropology, University of Notre Dame

With the goal of reaching Mars in the 2030s and expanding the human exploration footprint, there is a need to understand how humans survive and thrive extreme, unusual, and novel ecologies (i.e extreme environments). There is a particular need to not just over the short-term adjustment to these kinds of environments but also long-term, such as over generations, accommodation and adaptation. Current models of understanding human performance in space-relevant environments and human space science focus on immediate physiological or behavioral outcomes respectively, and approach human function through a biomedical model (e.g. the well-publicized twin study with twin brother astronauts Mark and Scott Kelly). However, the field of anthropology allows for alternative and more holistic perspectives in understanding how humans function over a range of time in an extreme environment. Further, anthropological ideas of human variation, niche construction, and phenotypic/genotypic plasticity and change are critical variables to factor into the development of predictive models encompassing the scope of bio-behavioral human changes. Using examples of current anthropological research of short- and long-term human habitation in highly challenging ecologies, such as high altitude, circumpolar, and rain forest environments I demonstrate the translational aspects of current biological anthropology research that can be used in current models of human physiological adjustment to long-duration space travel and extra-terrestrial habitation.

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From the lab to the forest: Does anatomy predict wrist kinematics in wild chimpanzees?

LAUREN SARRINGHAUS[1], CRAIG WUTHRICH[2] and LAURA M. MACLATCHY[1]

[1]Department of Anthropology, University of Michigan, [2]Department of Evolutionary Anthropology, Duke University

Several features of the great ape carpus have been hypothesized to relate to loading of the wrist during ulnar deviation, which is primarily thought to occur during vertical climbing and suspension. This study investigates the presence of some of these features among great apes, and examines the role of wrist adduction during different positional behaviors in chimpanzees. Video footage of ad libitum positional behavior was collected of Ngogo chimpanzees in Kibale Forest, Uganda. Frame-by-frame analysis was performed in iMovie, with wrist adduction angles extracted in ImageJ based on the axes of the forearm and the third metacarpal/third proximal phalanx, with the metacarpus parallel to the camera. Maximal ulnar deviation occurred during vertical climbing, but adduction also habitually occurred during knuckle-walking, vertical descent, as well as suspension. Analysis of three-dimensional shape variables extracted from 336 anthropoid carpals reveal great ape lunates to have reduced scaphoid facets and expanded radial facets, their triquetra to have enlarged lunate facets, and their capitates to have minimal contact with the fourth metacarpal. Each of these traits is plausibly associated with transmission of forces generated during adduction, as observed in chimpanzees, but future research is necessary to evaluate whether adduction during loading is consistent across great ape taxa for each behavioral mode. This study highlights the importance of testing hypothesized morpho-functional links by combining multiple lines of evidence from extant primates, in order to improve the reliability of functional inference from fossil morphology.

Behavior around the bend: Comparative analysis of the strength properties of long bones in *Saimiri sciureus* and *Saguinus nigricollis* from museum context using BoneJ

SIERRA R. SATER, SCOTT S. LEGGE and RISA L. LUTHER

Anthropology, Macalester College

Behavioral effects on wild primate skeletal remains are relatively unexplored. This study establishes a nondestructive analysis protocol to evaluate strength property patterns among *Saimiri sciureus* and *Saguinus nigricollis* long bones from museum context. We hypothesized that species from the same geographic region, utilizing similar locomotion, but with different behavior patterns would present similar strength properties. 64 paired long bones from individuals without traumatic injuries from each species were scanned with x-ray micro CT and analyzed for strength properties using the BoneJ plugin for ImageJ. Mediolateral and anteroposterior area moments of inertia and polar moments of inertia were calculated at 10% length intervals along the long axis of each bone to determine the resistance to bending and twisting forces, respectively. No clear pattern of statistically significant difference in lateral variation was discerned among bone pairs in *Saimiri*. Results for *Saguinus* suggest greater lateral variation among females. Sex comparisons showed significant differences, with males more resistant to bending and twisting forces in both species. Comparison of strength distribution of long bones across species by sex reveal dissimilar strength allocation. This protocol yields data directly related to stress factors of locomotion and behavior in wild primates through nondestructive techniques and utilizing museum collections. The comparative difference of strength in these two arboreal quadrupeds from Brazil and Columbia provides a more robust picture of how behavior may be reflected in skeletal remains and allows for future

inference of behavior for fossil and subfossil skeletal remains.

Co-circulating epidemics and health care access in early 20th century Alaska and Labrador: implications for emerging diseases of the present

LISA SATTENSPIEL[1], MEGAN MURRAY[1] and SVENN-ERIK MAMELUND[2]

[1]Anthropology, University of Missouri, [2]Work Research Institute, Oslo and Akershus University

Infectious diseases spread throughout a population due to complex interrelationships between a pathogen, the human host, and various aspects of the human environment. We address the connection between the regional availability of healthcare and disease-related mortality seen in Alaska and Labrador during the 1918-19 influenza pandemic. Our analyses consider the prevalence of other co-circulating infectious diseases as well as socioeconomic and sociocultural disparities related to ethnicity and sex. As previous research has provided a more detailed understanding of how these influences impacted regional variation in mortality in Labrador than in Alaska, our primary focus here is Alaska, with insights from Labrador used as a comparative guide. Medical facilities in Alaska were usually government or mission run hospitals and were more common in urban than in rural locales. Mortality rates suggest that the distance from one of these facilities may be correlated with the higher mortality and infectious disease morbidity rates seen among indigenous, rural peoples. We focus our discussion on the important role that access to adequate medical care and sources of health information played in a community's ability to minimize the effects of not only influenza, but also other infectious diseases and chronic conditions that may have been prevalent. We also address the effects of cultural and socioeconomic differences within and across communities. Results from this analysis have implications for the impact that open access medical care for all socioeconomic levels, ethnic groups, and geographic regions may have on reducing the mortality of a present-day emerging infectious disease.

A mixed model for the relationship between latitude and human post-cranial form

KRISTEN R. R. SAVELL[1], DAVID C. KATZ[2], BENJAMIN M. AUERBACH[1] and TIMOTHY D. WEAVER[3]

[1]Department of Anthropology, University of Tennessee, Knoxville, [2]Department of Cell Biology and Anatomy, University of Calgary, [3]Department of Anthropology, University of California, Davis

The general adherence of modern human body proportions to ecogeographic rules is frequently argued to be the result of thermoregulatory adaptation to climate. However, much of the history of human migrations follows the same clines that are associated with trends in body form. It is therefore important to test hypotheses about human adaptation to climate with approaches that account for population history and structure.

In this project, we investigate the relationship between latitude and post-cranial form in modern humans, with the goal of accounting for population history/structure and providing estimates of effects sizes and error. Using a multivariate quantitative genetics mixed model, we estimate morphological effects associated with latitude for long bone lengths and body size using osteometric data from 121 globally-distributed populations and geographically matched genetic data representing 28 populations. The model includes a random effect for population structure (genetic relatedness) and a fixed effect for latitude. We found that among-group variation was tightly correlated between limb lengths and body size measures respectively, but that these trait groups were fairly independent of each other. In addition, only bi-iliac breadth demonstrates a clear directional effect once population history is taken into consideration, though directional trends skew positive for humeral length and negative for distal limb lengths, supporting previous research.

By disentangling latitudinal effects from population structure using a mixed model approach, we add to the growing body of research exploring these strong underlying associations, and allow for a better understanding of the relationship between environmental and post-cranial morphological diversity.

Assessing age-related differences in frailty measurements among Pokot agro-pastoralists of Kenya

M. KATHERINE SAYRE[1], IVY L. PIKE[1], EMMA N. BUNKLEY[1], DOREEN A. ODERA[2], CASSIDY A. REEVES[3], NIMA TOOSIZADEH[4,5,6], JANE MOHLER[5,6,7,8], GENE E. ALEXANDER[10,11,12,13,14,9] and DAVID A. RAICHLEN[1]

[1]Anthropology, University of Arizona, [2]Sociology and Anthropology, North Dakota State University, [3]Anthropology, University of Colorado Boulder, [4]Biomedical Engineering, University of Arizona, [5]Arizona Center on Aging, University of Arizona, [6]Medicine, University of Arizona, [7]Interdisciplinary Consortium on Advanced Motion Performance (iCAMP), University of Arizona, [8]Surgery, University of Arizona, [9]Psychology and Psychiatry, University of Arizona, [10]Evelyn F. McKnight Brain Institute, University of Arizona, [11]Neuroscience Graduate Interdisciplinary Program, University of Arizona, [12]Physiological Sciences Graduate Interdisciplinary Program, University of Arizona, [13]BIO5 Institute, University of Arizona, [14]Arizona Alzheimer's Consortium

Frailty, a syndrome associated with age-related declines in function, increases mortality risk and is a growing public health concern in the US among older adults. Comparing frailty incidence across industrialized and small-scale societies may help us better understand how human senescence changes with different lifestyles and across human evolutionary history. However, diagnosing frailty within small-scale societies is difficult. Individuals are classified as frail if they fall into at least three of five clinically-based categories: unintentional weight loss, self-reported exhaustion, weakness, slow walking speed, and low physical activity (PA). The goal of this study was to use clinically-based frailty tests validated in the US to characterize age-related differences in Pokot agro-pastoralists, a small-scale society in northern Kenya. A sample of 47 Pokot participants were recruited (n_{male}=23,n_{female}=24,age=14-78) and completed a grip strength test, a 2-minute walk test, and wore accelerometers for two days to approximate clinically-based frailty tests for weakness, walking speed, and PA. Participants also completed two cognitive tests to assess spatial working memory (corsi block test) and motor function (finger-tapping test). No sex effects were observed for any test, and, unlike in industrialized societies, no age effects were found in grip strength ($F_{[6,40]}$=2.952,p=0.82) or spatial working memory ($F_{[6,40]}$=0.793,p=0.92). Significant age-related differences were found in the walk test ($F_{[6,40]}$=5.427,p<0.05), PA level ($F_{[6,40]}$=9.471,p<0.05), and motor function test ($F_{[6,40]}$=4.365,p<0.05). Using frailty assessments to characterize the effects of aging in different populations may be a useful way to contextualize and compare population health. The concept of "frailty" in non-Western contexts will be discussed.

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Variation in behavioral synchrony among white-bellied spider monkeys (*Ateles belzebuth*)

CLARA J. SCARRY[1,2], MARYJKA B. BLASZCZYK[2], ANDRÉS LINK[3,4,5] and ANTHONY DI FIORE[2]

[1]Department of Anthropology, Miami University, [2]Department of Anthropology, University of Texas at Austin, [3]Department of Biological Sciences, Universidad Nacional de los Andes, [4]School of Management, Universidad Nacional de los Andes, [5]Fundación Proyecto Primates, Fundación Proyecto Primates

Within primate groups, individuals may differ in their assessment of the relative benefits of alternative activities, making it difficult to achieve coordination and maintain spatial cohesion. The fluid association patterns of species that exhibit fission-fusion dynamics allow individuals to dissolve into temporary subgroups when these conflicts of interest arise, yet many of the

proposed benefits of group-living are predicated on the maintenance of the group as a spatially cohesive unit. Among spider monkeys (*Ateles belzebuth*) in Amazonian Ecuador, males collectively defend the community range, and the probability of both engaging in border patrols and winning intergroup encounters depends on the number of males present in a subgroup. Here, we examine whether males coordinate their activities with same-sex coalitionary partners to maintain the spatial cohesion necessary to benefit from these relationships. Between 2007 and 2014, we collected instantaneous focal animal samples of all adult members of one social group, during which we recorded both the behavior of the focal animal and its nearest neighbor. We fitted generalized linear mixed-effects models to examine whether behavioral synchrony was affected by the sex composition of focal-neighbor dyads, as well as exploring relationships between behavioral synchrony and dyadic association indices and social network centrality metrics. Male-male dyads exhibited greater behavioral coordination than either female-female or mixed-sex dyads, as we predicted given the "male-bonded" nature of spider monkey communities. We suggest that within primate groups, behavioral synchrony might be used as an additional, complementary metric to characterize the strength and quality of dyadic social relationships.

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Quantitative age-at-death estimation: A three-dimensional morphological analysis of the sternal extremity of the rib

AUDREY D. SCHAEFER

Anthropology, Texas State University

This study uses point-cloud data from the sternal rib end to produce a quantitative and objective age-at-death estimation. This research expands on the publications by Slice and Algee-Hewitt (2015) and Stoyanova et al. (2015), which created the forAge program to apply an age-at-death estimation technique using two shape scores to quantify the pubic symphysis surface morphology. The shape scores consist of: the Slice and Algee-Hewitt Score (SAH), which measures variance in surface morphology, and the Bending Energy (BE) score, which measures the minimum energy used to bend a thin plate over the surface morphology.

This study proposes two questions: Can the sternal rib end morphology be quantitatively measured to generate an objective age-at-death estimation? Will this method provide a more accurate age-at-death estimation than the commonly used phase-based methodologies? Point-cloud data from 80 microCT scanned ribs were used to create surface models of sternal rib ends. Models were imported into a custom forAge program, where SAH and BE scores were extracted. Then the shape scores and known age-at-death were used to generate 12 unique regression formulae for age-at-death estimation.

All regression formulae were significant at the p=0.05 level. R-squared values ranged from 0.09 to 0.33. Correlation coefficients of phase-based age estimates vs. known age ranged between 0.63-0.69, while regression-based age estimates vs. known age ranged between 0.31 to 0.58. Traditional phase-based methods performed more accurate age-at-death estimations than the new regression formulae. However, factors such as a skewed sample distribution may have affected the resulting formulae.

Endogenous Cortisol Production in Archaeological Hair from Lupaqa Colonists at the Site of Estuquiña in Southern Peru

BENJAMIN J. SCHAEFER[1,2,3], SLOAN R. WILLIAMS[4] and NICOLA O. SHARRATT[1,2]

[1]Anthropology, Georgia State University, [2]Center for Latin American and Latino Studies, Georgia States University, [3]Division of Biostatistics and Epidemiology, Georgia State University, [4]Anthropology, University of Illinois at Chicago

Using enzyme-linked immunosorbent assay (ELISA) to obtain both total and segmented cortisol levels, this study aims to reconstruct periods of duress in a colony established during political fragmentation and decentralization. Cortisol levels presented in this poster demonstrate a heightened periods of month-to-month and total duress leading up to death. Segmented cortisol levels provide a more nuanced understanding of stress variation beyond macroscopic examination of pathological conditions imprinted on bone through biocultural change and lived experiences in antiquity. This study draws on data derived through assaying endogenous cortisol in archaeological hair (n=12) from the site of Estuquiña. This site is located outside the modern city of Moquegua in the Moquegua Valley of southern Peru and was likely established as a Lupaqa colony settlement during the Late Intermediate Period (AD 1100-1476), a period characterized by regional socio-political decentralization and transition throughout much of Andean South America. Preliminary results from total cortisol suggest that there is a difference between cortisol levels in juveniles (18-64±19 ng/g) and adults (150-248±68 ng/g) as well as clinical data (104-134±40 ng/g). The segmented cortisol reconstruction suggest that spiked cortisol was heightened at the proximal strand of hair rather than the distal strand. This exploratory research suggests that the variation in cortisol levels at Estuquiña differs based on sex, pre- and post- pubertal development, and other confounders related to age at time of death.

Oh, Galago, What Big Hands (and Feet) You Have!: The Proportionally Large Cheiridia of Infant *Galago senegalensis*

MELISSA S. SCHAEFER[1,2] and LEANNE T. NASH[3]

[1]Anthropology, Salt Lake Community College, [2]Anthropology, University of Utah, [3]School of Human Evolution and Social Change, Arizona State University

Relatively large hands and feet are common characteristics of primate infants. This may be necessary to facilitate clinging to the mother and/or to facilitate grasping "large" substrates once the infants begin independent locomotion. *Galago senegalensis* infants are cached, not carried clinging. Congeneric galago infants travel more quadrupedally and less by vertical clinging and leaping than adults, though using similar substrates. We predict that the hands and feet of newborn *G. senegalensis* are not relatively larger when compared to other body segments, but they are relatively larger at the age they begin independent locomotion (~ 7 weeks). Linear lengths of hand, foot, trunk, upper arm, lower arm, thigh, and calf were measured at <10 days old until adulthood (~500 days old) longitudinally from 11 captive-born *G. senegalensis*. As newborns and at ~7 weeks, "adultness" of each subjects' segments was calculated as the percentage of adult segment length. Segments' adultness at each age were compared using a Friedman's test with post-hoc Nemenyi tests. Significant differences occurred among limb segments' adultness at both one week and at seven weeks. Newborns' hands and feet were 45% and 43% of adult size respectively while other body segments ranged from 36%-39% of adult size. At seven weeks, adultness of feet (83%) and hands (76%) exceeded that of other body segments (58%-69%) in percentage of adult length. The locomotor hypothesis was supported and we speculate that the larger hands of newborns might be related to gripping the mother while nursing.

New fossil dentary of *Chiromyoides* (Euarchonta, Plesiadapiformes): implications for ecological niche and body size

L. MILES. SCHAEFFER and DOUG M. BOYER

Evolutionary Anthropology, Duke University

The oldest known euarchontan fossils belong to plesiadapiforms, an apparently diverse group of primate-like mammals that appeared in the early Paleocene. Studies of plesiadapiform paleobiology contribute to our understanding of primate evolutionary origins. Here we describe a new fossil mandible of *Chiromyoides campanicus*, a plesiadapiform loosely analogized with extant Aye-Aye (*Daubentonia madagascarensis*) because of its stout mandible and robust

incisors. This specimen is the first to include a condyle and complete corpus, which allows for many basic measurements of jaw size. Principle Component Analysis on ten measurements of the dentary of 22 species of prosimians and six plesiadapiforms shows that *C. campanicus* and *Daubentonia* are uniquely similar and distinct from all other species, adding support to previous hypotheses that they are adapted for a similar lifestyle. With this in mind, we revisited the question of body mass for *C. campanicus*, usually thought to be a small species (314g) based on the size of its molar teeth. We generated a number of univariate and multivariate prediction models from different combinations of tooth and dentary measures. Using the equation that most accurately predicted the body mass of *Daubentonia*, we predicted the body mass of *C. campanicus*. Results suggest *C. campanicus* was much larger than previously thought (1378-1775g). Thus, in addition to having similar mandibular shape, *C. campanicus* was close to *Daubentonia* in size and also had molar microdonty. Therefore, the ecological parallels between the living Aye-Aye and *C. campanicus* were probably even greater than previously suspected.

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Heritability of coloration in *Mandrillus sphinx*

JERRED K. SCHAFER[1], ADAM D. GORDON[1], BARTHELEMY NGOUBANGOYE[2] and JOANNA M. SETCHELL[3]

[1]Anthropology, University at Albany-SUNY, [2]Centre de Primatologie, Centre International de Recherches Médicales, [3]Anthropology, Behaviour Ecology and Evolution Research (BEER) Centre, Durham University

Sex differences in coloration are classic examples of the response to sexual selection. For sexual selection to produce such dichromatism, color must be heritable. This study examines the heritability of coloration (measured as luminosity and redness) in *Mandrillus sphinx*, a species with high levels of sexual dichromatism and sexual size dimorphism. The sample consists of repeated color measurements over seventeen years for 96 pedigreed individuals from a semi-free-ranging colony at the Centre International de Recherches Médicales, Franceville, Gabon. We calculated narrow sense heritabilities (the proportion of variance due to additive genetic effects) of redness and luminosity using an animal model, a linear mixed effects model incorporating pedigree as a random effect. We included individual animal and mother IDs as random effects to account for repeated measures and maternal effects, and we modeled sex, age, and rank as fixed effects. Additional models added a sex-rank interaction term. Results show low but significant heritability in both traits (luminosity $h2$ = 0.10; redness $h2$ = 0.16). Results also show that age is the only significant covariate for luminosity at alpha = 0.05, while age, rank and sex are all significant covariates for redness. When we include the interaction of sex and rank in the redness model, the interaction is significant and age and sex remain significant, but rank does not. These results show that redness is heritable in mandrills, a key prediction of sexual selection models, and that previously identified associations between redness, sex, and rank persist when pedigree is taken into account.

An investigation of the association between forelimb bone and muscle morphology in non-human primates

HALEY M. SCHANER and MELISSA TALLMAN

Biomedical Sciences, Grand Valley State University

Paleontologists seek to reconstruct the life histories of fossil taxa based on bony remains. Locomotor reconstructions are common and typically rely on joint morphology or muscle enthesis patterning to make assumptions about muscle characteristics and to create a locomotor profile. However, there have been limited attempts to empirically quantify the relationships among muscle morphology, bony shape, and locomotor repertoire. In this study, we sought to quantify this relationship for the primate forelimb.

The forelimbs of thirteen medical laboratory specimens of *Macaca*, *Aotus, Chlorocebus, Papio,* and *Saimiri* were dissected. This sample contains a wide range of body sizes (from ~24kg in *Papio* to ~0.64kg in *Saimiri*) and locomotor repertoires (from largely terrestrial *Papio* to arboreal *Saimiri* and *Aotus*). Muscle fiber length, pinnation angle, and mass were collected for all muscles either directly or using photographs of individual muscles. Subsequently, the humerus, radius, and ulna were laser surface-scanned to construct three-dimensional models, and three-dimensional landmark coordinates were placed on muscle entheses and joint surfaces to quantify bony shape. Multivariate regressions were conducted to test for a relationship between aspects of bone shape and muscular variables.

We found a significant relationship between the morphology of *flexor carpi radialis*, *extensor carpi ulnaris*, and the rotator cuff group and the shape of the humerus ($p<0.05$). All significant correlations appeared to be related to allometry. These preliminary results show that allometry is potentially more important than differences in locomotor repertoire in driving the form-function relationship of muscular and bony anatomy among these primate forelimbs.

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New Markers for Anthropological Genetics: Massive Parallel Sequencing and Microhaplotypes

MOSES S. SCHANFIELD[1], KELLY LONG[2], KATRINA MADDELA[3], C. WOOTEN[4], ROBERT LAGACE[5], JOSEPH CHANG[6], KENNETH KIDD[7] and DANIELE PODINI[8]

[1]Forensic Science and Anthropology, The George Washington University, [2]Forensic Science, The George Washington University, [3]Forensic Science, The George Washington University, [4]Human Identification, Thermo Fisher Scientific, [5]Human Identification, Thermo Fisher Scientific, [6]Human Identification, Thermo Fisher Scientific, [7]Genetics, Yale University School of Medicine, [8]Forensic Sciences, The George Washington University

Advances in genetic testing have changed the field of anthropological genetics, starting with serological based testing, to electrophoresis, to early RFLP based DNA testing, to multiplex PCR based testing. The introduction of Massive Parallel Sequencing (MPS) sometimes referred to as Next Generation Sequencing (NGS) can reproduce SNP and STR based testing, but has also lead to the development of new marker types. Though the cost and time for analysis are increased because of the large number of tests performed, the cost per test has decreased.

Originally developed by Kenneth Kidd at Yale, and represented by results on Alfred from none MPS testing, it was found that the single haplotype sequencing accurately identifies the microhaplotypes originally identified. Microhaplotypes are two or more SNPs in a short sequence of DNA (<300 BP). As part of a forensic science project 34 mh with two, three or four SNPs yielding on average 4, 6 or 9 haplotypes and a maximum of 10, 21 or 45 genotypes were tested in three populations (European Americans [N=104], African Americans [N=100], and Southwestern Hispanics [N=90]).

The results of this testing generates between 5,120,000 and 51,200,000 reads for a single population, which is interpreted by computer assistance.

The population genetics, and anthropological genetics of these 34 loci which span the nuclear genome will be presented as Fst values and PCA.

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When the healthy choice isn't healthy or a choice: Structural determinants in cases of environmental injustice

LAWRENCE M. SCHELL

Anthropology, University at Albany, State University of New York

The structural determinants of human biology and health are clearly seen in cases of environmental injustice. People of the Akwesasne Mohawk Nation (AMN) living along the St.

Lawrence River have depended for generations on the river for food. In the 1980s the nation learned that manufacturing chemicals had contaminated river water and its fish. We describe detrimental health effects of this exposure including earlier sexual maturation in females, decreased testosterone secretion in adolescent boys and impaired ovulation in adult women. Avoiding all the consequences of exposure is difficult. The river is subject to overlapping jurisdictions (Canada, the US, Ontario, Quebec, and New York) with different structures of legal redress. These constitute a legal maze challenging for the tribe and impenetrable by individual AMN residents. Individuals are made responsible for mitigating the effects of the pollution. They are advised to avoid or limit consumption of locally caught fish. However, foods usually substituted for fish can contribute to increased overweight and obesity, already an existing problem, thereby increasing health risk also. In addition, traditional Mohawk beliefs and behaviors around diet, fishing, food preparation and family roles are under stress. The external structural factors leave Akwesasne individuals with this difficult decision: adhere to the public health message to choose other foods than local, toxicant-containing fish thereby abandoning a traditional food and the associated cultural features, or continue traditional ways regarding food and related practices of cultural significance but risk the effects of the contaminants. Neither choice is a healthy choice.

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Analyzing Cranial Shape Variability and its Application in Trauma Surgery

STEFAN SCHLAGER[1], MARC ANTON FÜSSINGER[2], WIEBKE SEMPPER-HOGG[2] and MARC METZGER[2]

[1]Biological Anthropology, University Freiburg, [2]Department of Oral and Maxillofacial Surgery, University Freiburg

Quantifying and analyzing the variability of the human anatomy is one of the core interests of biological anthropology. In this study we propose the application of knowledge about the shape variability of the human cranium to reconstruct defective regions. The assumption is that, given the intact part, the missing or defect regions can be predicted from a statistical shape model (SSM). An SSM incorporates information on the variability within this specific region. Our proposed method consists of two steps: 1. Creating an SSM and 2. fitting this SSM to a defective structure. Therefore, an SSM was created based on 131 cranial CT-scans. One specimen was established as template and subsequently registered to the entire sample. Using the registered surface meshes, an SSM was generated, parameterizing the shape variability of the cranial vault. The knowledge about the shape variation of the cranial vault in healthy patients was then exploited to estimate the missing parts. The accuracy of the reconstruction was evaluated based on 31 CT scans on which bony defects were created virtually. Six anatomical landmarks were placed manually to establish an initial spatial correspondence between the SSM and the target cranium, followed by an elastic registration of the SSM to the target. The accuracy of the reconstruction was determined by calculating the distances to the corresponding parts on the intact skull. At a level of 0.47 mm, the mean error of reconstruction was very low and it could be shown that this approach helps to reconstruct large size defects.

Dental microwear texture analysis in bioarchaeology

CHRISTOPHER W. SCHMIDT

Anthropology, University of Indianapolis

Dental microwear texture analysis (DMTA) is a non-destructive means of paleodietary reconstruction that characterizes microscopic features found on dental chewing surfaces. Its efficacy in primatology and paleoanthropology has been demonstrated repeatedly. Recent efforts have applied DMTA to humans from bioarchaeological contexts. The DENTALWEAR project, based at the University of Indianapolis, is a collaborative initiative that studies DMTA in humans from across the globe. The project reports notable differences between foragers, farmers, and pastoralists. The current study seeks to find differences within one of these means of subsistence, the foragers. The sample includes 30 Middle/Late Archaic adults who date to 5,500 years ago, and 32 Early/Middle Woodland adults who are 1,500 years old. All are from Indiana. The sexes were pooled. Data collection followed standard procedures: the study employed a white-light confocal profiler to reconstruct Phase II wear facet micro-topography. Data point spacing was submicron and leveling and cleaning took place via SolarMap® software. Surface variables were complexity and anisotropy, which were computed using scale-sensitive fractal analysis software (Sfrax® and Toothfrax®). ANOVA led to rejecting the null for complexity (means = 1.32 and 1.63, respectively; p = .046), but not for anisotropy (means = .0026 and .0024). The findings indicate an increase in dietary hardness but no change in feature directionality. The DMTA results support subsistence, SEM-based microwear, isotopic, and oral pathology findings for these populations and further demonstrate DMTA's ability to tease out subtle, but meaningful, dietary differences in bioarchaeological samples.

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Of infants and infections: Investigating 20th century mortality patterns in Newfoundland and Labrador

DANA M. SCHMIDT

Anthropology, University of Missouri

During the first 2-3 decades of the 20th century, most European and North American nations had achieved increases in life expectancy of over 60 years. These changes, part of a well-recognized epidemiologic transition, were largely due to reductions in infectious disease prevalence as a consequence of improvements in sanitation and social services. Typically, substantial declines in infant mortality are observed relatively late in this transition, improving only after considerable advancements in maternal care and control over infectious diseases of childhood were underway. We use 20th century vital statistics records and archival materials from Newfoundland and Labrador to examine the pattern of infectious disease, its relationship with infant mortality, and these effects on the epidemiologic transition, with a specific focus on infant and childhood mortality as a barometer for population health. Results show that infant mortality, largely from infectious disease, was incredibly high throughout the first half of the century, with the most drastic reductions in infant mortality occurring in the post-WWII years, from the late 1940s through the 1950s. Infant mortality rates averaged 92 infant deaths/1000 live births from 1941-1945, and dropped substantially to 36 infant deaths/1000 live births in 1960, with continuous decline in between. These high rates contributed to the delayed completion of the second epidemiologic transition in Newfoundland relative to other Canadian provinces and other Western nations. The effects of factors including sanitation, nutrition, and other medical and public health efforts during this time period and their relationship to infant, infectious disease, and total mortality are considered.

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Genetically patterned dental phenotypes show evidence for diet-related evolutionary change in platyrrhine primates

CHRISTOPHER A. SCHMITT[1], SIOBHAN B. COOKE[2], MARIANNE F. BRASIL[3], TESLA A. MONSON[3] and LESLEA J. HLUSKO[3]

[1]Department of Anthropology, Boston University, [2]Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [3]Human Evolution Research Center, Department of Integrative Biology, University of California, Berkeley

Genetically patterned (GP) dental phenotypes have been shown in catarrhine primates to change over evolutionary time in ways suggestive of dietary niche partitioning and replacement. Platyrrhine primates, as a radiation, have been

hypothesized to have differentiated primarily due to dietary differences. To test this hypothesis, we used two GP dental phenotypes – the molar-molar inhibitory cascade (MMC) and the premolar-molar genetic module (PMM) – to investigate patterns of variation in platyrrhine mandibular dentition across 335 museum specimens representing 32 taxa in 14 genera. Preliminary results suggest that the majority of atelid and pitheciid platyrrhines occupy a relatively undifferentiated dental morphospace, consistent with hominoid morphology associated with frugivory. PGLS regressions of these traits using a molecular phylogeny modified from *10ktrees* suggest that, although platyrrhines largely show variation consistent with Brownian motion models of evolutionary change (PMM: Pagel's $\lambda = 0.74$; MMC: Pagel's $\lambda = 0.74$), the genera *Alouatta* and *Plecturocebus* appear to be outliers. While the change seen in *Alouatta* is consistent with folivorous hominoids (like *Gorilla), Plecturocebus* occupies a unique morphospace that is difficult to interpret, comparable only to hominins. Among the Cebidae, the loss of the third molar in most callitrichin taxa may have resulted in changes to relative terminal molar size, suggesting potential selection for change in the MMC to accommodate M_3 loss. With further analysis, the dietary and taxonomic signals in GP dental phenotypes should give greater resolution in determining both fossil platyrrhine taxonomy and behavior and patterns of evolutionary change in platyrrhines.

Digit clearance patterns in primates vary by limb and substrate reflecting different strategies between arboreal and terrestrial locomotion

DANIEL SCHMITT[1], ANGEL ZEININGER[1], PIERRE LEMELIN[2], CHARLOTTE E. MILLER[3], MICHAEL C. GRANATOSKY[4], JANDY B. HANNA[5], ROSHNA E. WUNDERLICH[6], TRACY L. KIVELL[7], MICHAEL D. ROSE[1] and JEAN E. TURNQUIST[8]

[1]Evolutionary Anthropology, Duke University, [2]Division of Anatomy, Department of Surgery, University of Alberta, [3]Computing, Engineering and Science, University of South Wales, [4]Organismal Biology and Anatomy, University of Chicago, [5]Biomedical Sciences, West Virginia School of Osteopathic Medicine, [6]Biology, James Madison University, [7]Anthropology and Conservation, University of Kent, [8]Anatomy and Caribbean Primate Research Center, University of Puerto Rico

During swing phase of walking, animals are faced with the challenge of keeping digits clear from the substrate. On the ground, animals can flex or abduct the limbs, strategies that shorten effective limb length during the swing phase and require muscular effort. On a branch or pole, however, primates can allow their long limbs to swing below the substrate, lengthening the swinging limb and increasing limb protraction, while allowing for flexion and compliance of the supporting limb. This pattern was suggested in several early studies carried out at the SBU Locomotion Lab, but was never tested. We examine digit clearance patterns in 24 primate species, including chimpanzees and gorillas, and 10 arboreal and terrestrial non-primate mammal species. On poles, almost all species swing their forelimb slightly to the side of the support and allow the hand to drop alongside or below the level of the pole. However, the swinging hindlimb is relatively more abducted and flexed and the foot remains most often at or above the level of the pole. On the ground, animals often use abducted limbs, especially great apes, and flexed limb joints to provide ample clearance of the hand and foot. Hindlimb similarities between ground and pole suggest that hindlimb motion may be constrained by the risk of interfering with the supporting hand. Shifts in forelimb behavior from ground to pole, along with other changes in forelimb function may represent a key mechanical adaptation for arboreal locomotion, providing a wide swing arc with limited muscular effort.

Can honey consumption be detected from metagenomic gut microbiome data?

STEPHANIE L. SCHNORR

Evolution and Cognition Research, Konrad Lorenz Institute

Honey has been an ever present component of the human diet, going back long before agriculture, domestication, and resource management. Honeycomb is an important food resource that supplies vital nutrition in the form of raw energy from liquid honey, fats and proteins from the larvae, and vitamins and antioxidants from the fermented pollen ("bee bread"). However, accounting for honey consumption in the diet of traditional subsistence-based societies, as well as non-human primates, is challenging. Honey is commonly consumed outside of the central living place by the often solitary honey hunter. Actual foraging patterns for wild honey vary and can be sporadic or opportunistic, usually accomplished by men while ranging far from home, hampering observer documentation. A survey of shotgun metagenomic data for carbohydrate-active enzymes (CAZymes) brings to light a number of genes involved in pathways relating to the breakdown of products commonly found in honeycomb such as flavonoids, acids, and exoskeletons. This suggests that honey consumption, which can be enigmatic or cryptic behavior, may be traceable, but not quantifiable, through CAZyme annotations of fecal metagenomic data. Fecal samples from Hadza of Tanzania covering two full seasonal cycles as well as samples from the Matses of Peru, are interrogated in-silico for CAZyme gene presence in light of dietary data. Results support the notion that honeycomb consumption may be traced through presence of enzymes specific to honeycomb products, and may aid our understanding of the ubiquity of honeycomb acquisition and consumption, and serve as a boon to human and nonhuman primate studies.

A new method for soft tissue removal for osteological analysis and preservation

JOSHUA SCHOFIELD

Anthropology, Metropolitan State University of Denver

Soft tissue removal is a necessary and time consuming step for osteological analyses and curation. Powdered Brewery Wash (PBW) (Five Star Chemicals, Commerce City, Colorado), a buffered alkaline detergent, is known in the brewing industry for its ability to quickly break down lipoproteins that are a byproduct of the fermentation process. This pilot study illustrates that PBW is efficient for the removal of soft tissues, while leaving the bone undamaged. A solution of PBW and water was tested with pig (*Sus scrofa)* ribs, which were allowed to soak for four hours in a warm-water bath (~ 95°F). The PBW solution was compared to an enzymatic detergent solution and a water control. The ribs treated with the PBW solution took the least amount of time to finish manually cleaning compared to the enzymatic detergent and water (mean time of 53.5 seconds, 132 seconds, and 237.5 seconds, respectively). Four trials were conducted with the three treatments. A Kruskal-Wallis test comparing the treatments was significant (p= 0.0280). Based on the results of this analysis PBW shows potential as an agent to aid in soft tissue maceration. Future plans for this project include running more trials as well as testing effectiveness of the PBW solution on other skeletal elements and varying taphonomic conditions.This pilot study shows that PBW as a macerating agent is a promising method.

Role of age and sex in determining glucocorticoid response to parasite infection

VALERIE AM. SCHOOF[1,2,3], TONY L. GOLDBERG[4,5], DINA GREENBERG[2], GABRIELA MASTROMONACO[6] and COLIN A. CHAPMAN[3,7]

[1]Biology Program, Multidisciplinary Studies, Glendon College, York University, [2]Biology, York University, [3]Anthropology, McGill University, [4]Pathobiological Sciences, University of Wisconsin-Madison, [5]Nelson Institute for Environmental Studies, University of Wisconsin-Madison, [6]Reproductive Programs, Toronto Zoo, [7]School of Environment, McGill University

Parasitic infections can be costly for hosts. Fecal glucocorticoids (fGC) are one way to quantify potential costs in the absence of clinical symptoms. We conducted a parasite removal experiment in vervets (*Chlorocebus pygerythrus*) at Lake Nabugabo, Uganda. Our study had five phases: I) "pre-deworming"; II) "deworming" with ivermectin treatment, and "post-deworming"

subdivided into III) 0-4 weeks, IV) 5-8 weeks, and V) 9-23 weeks after treatment. Parasite eggs were found in all phases except Phase IV. We used repeated-measures GLMM and pairwise comparisons to examine the effects of phase, age, and sex on log-transformed fGC levels (N=218). We examined all combinations of phase (I, III-V), age (adult, subadult, juvenile), sex (male, female), and interactions among these variables, comparing models using the Bayesian Information Criterion. The two best models both included phase, and one also included age (ΔBIC=0.298). Adults (3.41±5.13ng/g) and juveniles (1.97±1.18ng/g) had significantly higher fGC levels than subadults (1.89±1.40ng/g; F=98.870, df=3,114, p<0.001). Mean fGC levels differed significantly across study phases: despite continued excretion of parasite eggs, fGC levels decreased in weeks 0-4 (1.02±0.35ng/g) compared to baseline levels (1.41±0.55ng/g), increased in weeks 5-8 (4.03±2.85ng/g) despite the absence of eggs in feces, then rose again in weeks 9 (6.04±7.33ng/g) and remained high for the remainder of the study period (F=3.419, df=2,55, p=0.040). The immediate fGCs decrease following deworming likely represents parasite death despite continued egg excretion, while the large increase in fGC during the likely period of parasite reinfection indicates that this process is stressful, even if parasites are not yet reproducing.

Contextualizing the Biocultural Approach with Practice Theory: Physical Activity and Inequality During the Andean Middle Horizon and Late Intermediate Period

SARAH SCHRADER[1], MARK HUBBE[2,4] and CHRISTINA TORRES-ROUFF[3,4]

[1]Faculty of Archaeology, Leiden University, [2]Department of Anthropology, The Ohio State University, [3]Anthropology, University of California, Merced, [4]Instituto de Arqueología y Antropología, Universidad Católica del Norte

The Andean Middle Horizon (AD 500–1000) has been characterized as a period of increasing prosperity with burgeoning regional economic connections, which gradually transitioned into the less centralized Late Intermediate Period (AD 1000–1500). Recent bioarchaeological investigations have revealed evidence of shifts in socioeconomic inequality and social identity diversification during these periods. Informed by theories of practice and intersectionality, we examine entheseal data from adults interred at two sites in the vicinity of San Pedro de Atacama, Chile—Middle Horizon Solcor 3 (*n*=109) and Late Intermediate Period Coyo 3 (*n*=44)—to better understand the social correlates of physical activity during this time. We analyze these data within a biocultural framework aimed at understanding the temporal, political economic, and cultural contexts of human biological variation. ANCOVA analyses controlling for age show that, at both sites, females had similar entheseal change scores and significantly more pronounced entheseal changes than males, particularly in upper-body entheses. Moreover, Coyo 3 males displayed evidence of more strenuous activity than their counterparts in Solcor 3 (bilateral shoulder, elbow, wrist, and hip). Grounded in anthropological and archaeological theory, we consider this study biocultural in its effort to explain variation in biomechanical phenomena as embodiments of sociocultural processes. As such, we argue that these results may reflect status-based variation in men's labor practice built upon a sexual division of labor that appears durable through time.

The Effect of Diet on Amylase Production

MCKENZIE A. SCHRANK[1,2], CASSADY Y. URISTA[1] and JASON E. DAVIS[2]

[1]Anthropological Sciences, Radford University, [2]Biology, Radford University

The enzyme alpha-amylase is one of the digestive enzymes responsible for breaking down dietary starch. Its production is controlled in part by the number of copies of AMY1 genes an individual possesses. Previous research has suggested that alpha-amylase production is related to the amount of starch in the traditional diet of the culture, and is therefore, culturally variable. This research examines the evolutionary effects of alpha-amylase and diet. 25 Peruvians and 17 North Americans were studied and each participant provided both a dietary survey and 1-3 ml of saliva. In addition, North Americans provided salivary samples both while on their normal diet and after several weeks of exclusively Peruvian-typical diet. Saliva was analyzed for alpha-amylase via ELISA for variations both between cultures and in North Americans before and after dietary change. Analysis of dietary surveys suggest that the modern Peruvians have a higher starch diet than those from North America. It was expected that the levels of amylase would vary between the cultures; with higher levels in Peruvians. However, no significant differences were found in optic density of amylase between populations. Since the relationship between amylase production and population has been argued to be related to population-level adaptation and not individual diet, we did not expect, nor did we find, differences in the North American samples. This suggests that any differences in the traditional diets of these groups was in types of dietary starch and not amount of dietary starch, and therefore evolutionarily invisible.

"Sigma taxonomy" and the lack of a clear boundary between *Australopithecus* and *Homo*

CAITLIN M. SCHREIN[1], J. FRANCIS THACKERAY[2], JULIEN BENOIT[2] and SUSAN DYKES[2]

[1]N/A, Independent Researcher, [2]Evolutionary Studies Institute, University of the Witwatersrand

Despite our limited knowledge of the origin of the genus *Homo*, the concept of a "*Homo* boundary" between the genus and its australopithecine predecessors is invoked by alpha taxonomy. We propose, instead, that Plio-Pleistocene hominins represent a morphological and genetic spectrum of variation, conceivably resulting from gene flow between populations.

We applied a UPGMA cluster analysis using PAST software with "log sem" statistics based on pairwise linear regression analyses of *Pan troglodytes* and *Pan paniscus* cranial measurements to obtain a phenetic tree (n = 68). A log sem approach does not reveal significant morphological differences – consistent with genetic evidence of hybridization between chimpanzees and bonobos within the last 500 thousand years (De Manuel et al, 2016) – but the application of UPGMA generally discriminates between the groups, with just three *P. troglodytes* specimens in the *P. paniscus* group.

Similarly, a phenetic tree was obtained for cranial specimens of *Australopithecus* and *Homo* (n = 13). Specimens attributed to *A. africanus* (Sts 71 and Sts 5) from South Africa and specimens attributed to *H. habilis* (KNM-ER 1813 and OH 24) from East Africa formed a group; they were more similar to one another than to robust australopithecines and other *Homo* specimens in the analysis.

We failed to identify a clear distinction between *A. africanus* and early *Homo*, bringing the concept of a "*Homo* boundary" into question. Recognizing this, we appeal for the use in paleoanthropology of a probabilistic definition of a species, associated with "sigma taxonomy" (s or Σ for spectroscopy).

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The Burden of Care: Exploring the relationship between morbidity load and need for care at the Middle Archaic (8000 - 5000 BP) site of Carrier Mills, IL

ALECIA SCHRENK

Anthropology, University of Nevada, Las Vegas

Healthcare provisioning is a conscious choice that places a burden on the community as resources and labor are expended in the hopes of recovering a member. This study combines two analytical frameworks, the Bioarchaeology

of Care with the Global Burden of Disease, to generate a multiscalar examination of disease, healthcare, and morbidity load in the Archaic (10,000 – 2500 BP) population of Carrier Mills, Illinois. The people of Carrier Mills were seasonally mobile foragers who congregated at the site during the fall and winter, which may have provided a buffer when caring for their sick and disabled members during the challenging weather conditions during those months. Rates of treponemal infection, general infection, and trauma were high in this population. The presence of many older individuals at the site indicate that healthcare and accommodation may have helped offset an apparently high morbidity load. This analysis will provide insight into how this population, with such a high morbidity load, maintained longevity for so many of its members.

Lassitude as a regulatory system for behavioral adjustment to energetic stress in humans: Evidence from six diverse cultures

JOSHUA M. SCHROCK[1], J JOSH. SNODGRASS[1], NIRMALA NAIDOO[2], PAUL KOWAL[1,2,3] and LAWRENCE S. SUGIYAMA[1]

[1]Department of Anthropology, University of Oregon, [2]Multi-Country Studies Unit, World Health Organization, [3]Research Centre for Generational Health and Ageing, University of Newcastle

Humans are characterized by a set of energetically expensive traits including large brains, long lifespan, high fertility, and multiple dependent offspring. How we afford such energetically expensive traits is a longstanding question in evolutionary anthropology. Here we describe an emotion, lassitude, and propose that it functions as an internal regulatory mechanism for the facultative behavioral adjustment of energy use in response to energetic stress. The hypothesized system detects cues of energy stress and promotes behavioral and physiological changes that reduce engagement in energetically costly activities. We tested two predictions derived from this model: (1) that energetic stress from a greater burden of chronic disease would be associated with stronger subjective reports of lassitude, and (2) that stronger subjective reports of lassitude would be associated with poorer performance on tests requiring physical exertion. Data were drawn from SAGE Wave 1, which features samples of younger (ages 18-49) and older (ages 50+) adults in six countries: China, Ghana, India, Mexico, Russia, and South Africa (12 samples, total N=37,251). The first prediction was supported in all twelve samples (all $p<0.05$). Associations consistent with the second prediction were observed in all samples, though in three of the samples the effect was not statistically significant. Multilevel models nesting individuals within samples supported both predictions in the aggregated study population (Prediction 1: $\beta=0.307$, S.E.=0.024, $p<0.001$; Prediction 2: $\beta=-0.156$, S.E.=0.033, $p<0.001$). These results provide cross-cultural support for our model and may offer insight on how humans are able to maintain their unique combination of life history characteristics.

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A quantitative genetic approach to assessing hominoid mandibular evolution

LAUREN SCHROEDER[1,2] and NOREEN VON CRAMON-TAUBADEL[3]

[1]Department of Anthropology, University of Toronto Mississauga, [2]Human Evolution Research Institute, University of Cape Town, [3]Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo

A recent study showed that much of the diversity in extant hominoid cranial form can be explained by either stochastic divergence or strong stabilizing selection acting on most lineages. However, directional selection was required to explain the divergence of *Homo* and *Pan*, and the divergence of the lesser and great ape lineages. Here we test whether the same evolutionary processes underlie the evolution of mandibular form in 15 extant hominoid taxa. A maximum likelihood approach based on a Brownian motion model was used to calculate nested hypothetical ancestors for 18 mandibular traits, and rates of evolution along each branch of a fully-resolved phylogeny were calculated using Lande's generalized genetic distance. Overall, the results showed similar evolutionary rate patterns as those found for the cranium, with most lineages characterized by stabilizing selection or stochastic divergence. However, directional selection was necessary to explain the divergence of the human lineage and the divergence of the lesser and great apes. Reconstructed selection vectors identified which traits were subject to strong positive or negative selection pressures. The divergence of the lesser apes was characterized by positive selection on relative ramus breadth and condyle width, and negative selection on overall corpus length and ramus height. Congruent with selection for a parabolic dental arcade, the divergence of *Homo* was characterized by strong negative selection on the overall alveolar length and width of the anterior corpus, while the width of the posterior corpus and the relative size of the posterior dentition was under positive selection.

Ancient *Mycobacterium leprae* genomes reveal an unexpected diversity of leprosy in medieval Europe

VERENA J. SCHUENEMANN[1,2,3], CHARLOTTE AVANZI[4], BEN KRAUSE-KYORA[5,6], ALEXANDER SEITZ[7], ALEXANDER HERBIG[6], ANDREJ BENJAK[4], SARAH INSKIP[8], G. MICHAEL TAYLOR[9], PUSHPENDRA SINGH[10,4], JESPER L. BOLDSEN[11], HELEN D. DONOGHUE[12], SONIA ZAKRZEWSKI[13], KAY NIESELT[7], STEWART T. COLE[4] and JOHANNES KRAUSE[2,3,6]

[1]Institute for Evolutionary Medicine, University of Zurich, [2]Institute for Archaeological Sciences, University of Tübingen, [3]Senckenberg Centre for Human Evolution and Palaeoenvironment, University of Tübingen, [4]Global Health Institute, Ecole Polytechnique Fédérale de Lausanne, [5]Institute of Clinical Molecular Biology, Kiel University, [6]Archaeogenetics, Max Planck Institute for the Science of Human History, [7]Centre for Bioinformatics, University of Tübingen, [8]McDonald Institute for Archaeological Research, University of Cambridge, [9]Department of Microbial Sciences, University of Surrey, [10]Department of Microbiology and Biotechnology Centre, The Maharaja Sayajirao University of Baroda, [11]Department of Anthropology (ADBOU), University of Southern Denmark, [12]Centre for Clinical Microbiology, University College London, [13]Department of Archaeology, University of Southampton

Studying ancient DNA allows us to retrace the evolutionary history of human pathogens, such as *Mycobacterium leprae*, one of the two causative agents of leprosy. Leprosy is one of the oldest recorded and most stigmatized diseases in human history. The disease was prevalent in Europe until the 16th century and is still endemic in several countries with over 200,000 new cases recorded annually.

Previous studies on worldwide modern and European medieval *M. leprae* genomes revealed that they cluster into five separate lineages of which two were present in medieval northwestern Europe. In our present study, we analyzed additional medieval *M. leprae* genomes including the so far oldest *M. leprae* genome from one of the earliest known cases of leprosy in the United Kingdom—a skeleton from the Great Chesterford cemetery with a calibrated date of 415–545 AD. This dataset provides a genetic time transect of *M. leprae* diversity in Europe over the last 1500 years. We find four of the five known distinct *M. leprae* lineages to be present in the early medieval period, and three lineages were detected within a single cemetery from the high medieval period. Altogether these findings suggest a higher genetic diversity of *M. leprae* strains in medieval Europe at various time points than previously known.

The resulting more complex picture of the past phylogeography of leprosy in Europe impacts current phylogeographical models of *M. leprae* lineages and highlights how studying ancient *M. leprae* strains improves understanding of the history of leprosy worldwide.

Bone modeling patterns in the midface of modern humans during ontogeny: a study of intraspecific variability

ALEXANDRA SCHUH and SARAH FREIDLINE-STIMMAN

Human Evolution, Max Planck Institute for Evolutionary Anthropology

Ontogenetic changes in craniofacial morphology are the result of a process called bone modeling. It is the combined activity of cells that create and remove bone tissue to model its shape. Bone modeling is generally assumed to be species' specific. However in humans, this assumption has never been tested in a large sample across regional groups. Here for the first time, we show bone modeling patterns in the midface of *Homo sapiens* from three geographically diverse populations, each with distinct facial adult morphologies: Western Europe (n = 48), Inuit (n = 20) and Khoisan (n = 25). Previous studies have shown that ontogenetic differences in the midface between Inuit and Khoisan arise early during ontogeny. How this translates to the bone modeling patterns is the central question in this study. For this purpose, we analyzed midfacial bone modeling patterns in an ontogenetic series ranging from birth to late childhood. High-resolution replicas of the bone surface were created using epoxy resin and investigated with a digital stereo microscope. Our results show that bone formation and resorption occur in the same regions of the midface in each regional group, suggesting that patterns of bone modeling are genetically determined within a species. This finding is encouraging for interpreting facial bone modeling patterns on fossil species where studies of intraspecific variability are rare due to small sample sizes.

Market integration, meaning and deviation in cultural life priorities among indigenous rural Bolivians

ALAN F. SCHULTZ[1] and TOMÁS HUANCA[2]

[1]Anthropology, Baylor University, [2]Director, Centro Boliviano de Investigacion y Desarrollo Socio Integral

Community integration into a market economy introduces new regimes of belief and behavior that reshape the meaning of life priorities and status markers. Numerous studies have linked shifts in status hierarchy to health via the psychosocial stress process but struggle to identify underlying mechanisms. In transitional rural societies, new regimes of status do not simply replace previous systems but are instead subsumed into existing cultural norms, increasing the difficulty of pinpointing changes in specific behaviors and items. In this study, we use residual agreement analysis to assess the patterning of agreement within a cultural model of life priorities among a sample of 47 indigenous Mojeño respondents from two communities with varied levels of market integration collected during 2016-17 in Bolivian Amazonia. The analysis is informed by several months of participant observation data collected before the start of the present study. We find that all respondents share a model of life priorities (7.5 eigenvalue ratio). We also identify a systematic intercommunity deviation in preferences for a subset of culturally meaningful items and behaviors tied to key parts of the stress process model, namely, 1) social stressors and 2) resistance resources. We conclude with a discussion of the items identified in the analysis including differences in the perceived necessity of ritual social roles and how these might link to psychosocial stress buffering and chronic stress outcomes. The study replicates similar results we have obtained among other rapidly integrating forager-horticulturalist societies in Bolivian Amazonia.

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Ethnohistory, Social Organization and Genetic Diversity in Northwest Pakistan

THEODORE G. SCHURR[1], MUHAMMAD TARIQ[2] and HABIB AHMAD[2]

[1]Anthropology, University of Pennsylvania, [2]Genetics, Hazara University

In this project, we conducted a detailed genetic and ethnographic analysis of tribal populations from the Buner and Swabi areas of Khyber Pakhtunkhwa Province (KPP) of Pakistan. We worked with five tribes (Yousafzai, Gujars, Syeds, Jadoons and Tanoli) to elucidate their origins and affinities with other populations from the Indian subcontinent, Europe, the Near East and Central Asia. All KPP tribes were remarkably diverse in terms of the West Eurasian, South Asian and East Eurasian mtDNA haplogroups present in them, with Syeds, Yousufzai, and Jadoons showing similar maternal genetic profiles. KPP tribes also had varying frequencies of West Eurasian, South Asian and East Eurasian Y-chromosome haplogroups, with Syeds, Yousufzai, and Gujars showing similar paternal genetic profiles. In addition to these sex-mediated genetic differences, we further noted lineal effects in the distribution of Y-STR haplotypes within the main Y-chromosome haplogroups present in these populations (O3, R1a, R1b). We used the resulting data to examine the relationship between tribal history, social organization and genetic diversity in KPP tribes.

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Oral Health in the North Atlantic during Viking and Medieval Times: The Good, the Bad, and the Ugly

G. RICHARD SCOTT, ROSE L. PERASH, LAURA CIRILLO, CORTNEY N. HULSE, CASSIE E. SKIPPER, STEPHANIE J. COLE, MICHAELA J. SCHROEDER and CHELSEA ARCE

Anthropology, University of Nevada Reno

For coetaneous populations residing in a well-defined geographic region with similar subsistence economies, it is reasonable to assume a consistent pattern of oral health. This was not the finding when caries, antemortem tooth loss (AMTL), periapical abscesses (PA), and linear enamel hypoplasia (LEH) were observed in populations of the North Atlantic (Greenland, Iceland, Norway, Denmark; A.D. 800-1400). The most remote group, the Greenlandic Norse, had the healthiest oral cavities with no caries, moderate AMTL and PA, and surprisingly little LEH. Similarly, Icelanders had no caries, moderate PA and LEH, but had unusually high frequencies of AMTL, three times higher than the other groups. Medieval Norwegians from Trondheim had some caries, a moderate incidence of AMTL, and much higher frequencies of PA and LEH. Danish Vikings, who preceded the medieval Norse by a few centuries, had by far the highest frequency of caries but only moderate incidences of AMTL, PA, and LEH. All Norse groups had pastoral economies augmented by fishing. Therefore, between group contrasts must involve variables other than just diet. For example, the high protein diets of Greenlanders and Icelanders precluded dental caries but Icelanders had three times as much AMTL, perhaps reflecting the unique volcanic substrate of Iceland. Why the Vikings had the highest caries rate is puzzling but might involve a unique focus on highly refined sugars, such as the honey in mead. The high frequencies of LEH and abscesses in Norwegians possibly reflect issues with living conditions in settled communities during the Middle Ages.

The paleoecological context of *Homo erectus* in East Turkana, northern Kenya between 2.0 and 1.4 Ma

JEFFREY A. SECKINGER[1], FELIPE S. TORRES[2], KAEDAN P. O'BRIEN[3], LAUREN ANDERSON[4], AMANDA MCGROSKY[5], KAYLA ALLEN[6], BRANDON ZELLER[6], DEGSEW ZERIHUN[7], AMANDA GUERRERO[8], MARYSE D. BIERNAT[5], LAURA E. HUNTER[9], ASHLEY S. HAMMOND[10,4], DAVID B. PATTERSON[4,6] and DAVID R. BRAUN[4]

[1]Koobi Fora Research and Training Program, The George Washington University, [2]Instituto de Ciencias de la Tierra, Universidad Austral de Chile, [3]Departments of Anthropology and Integrative Biology, University of Wisconsin-Madison, [4]Center for the Advanced Study of Human Paleobiology and Department of Anthropology, The George Washington University, [5]School of Human Evolution and Social Change, Arizona State University,

[6]Department of Biology, University of North Georgia, [7]Authority for Research and Conservation of Cultural Heritage, Ministry of Culture and Tourism, Addis Ababa, Ethiopia, [8]Department of Anthropology, University of La Verne, [9]Department of Ecology, Evolution, and Environmental Biology, Columbia University, [10]Human Origins Program, Department of Anthropology, National Museum of Natural History

Several key morphological features that distinguish later genus *Homo* from *Australopithecus* first appear *Homo erectus*. The fossil record at East Turkana in Northern Kenya dating between 2.0 and 1.4 Ma offers a large paleoecological dataset to test different hypotheses about the selective pressures that affected hominin adaptation and evolution. Using existing and newly collected mammalian abundance data, we explored differences in the environmental context of *Homo erectus* by comparing the Upper Burgi (1.99-1.86 Ma) and the Okote (1.56-1.38 Ma) members. Our investigation of abundance data identified various taxa to the sub-family or genus level. We find a slight increase in alcelaphines from the Upper Burgi to the Okote members, however their proportion is far greater in archaeological assemblages than traditional paleontological collections. This may support the previous assertion that hominins accessed a disproportionately large number of alcelaphines during the Okote member. Finally, the data indicate that C4 dominated grasslands expanded between the Upper Burgi to the Okote members. This expansion, however, was negligible relative to earlier members in the Turkana Basin and may reflect an increase in mesic-C4 environments. Overall, our study suggests relatively minimal changes in the mammal community between the Upper Burgi and Okote members. This could imply that major hominin adaptations during this period did not closely track ecosystem changes and that hominins were beginning to become decoupled from their surrounding environments, as has been suggested by previous authors.

Home Ranges of Wild Aye-ayes (*Daubentonia madagascariensis*) in the continuous forest of Torotorofotsy, Madagascar

TIMOTHY M. SEFCZEK[1], FENONAMPIANA A. RANDRIATSIMIALONA[2], HARRISON RANDRIANJATOVO[2], JOSHUA SADVARI[3] and EDWARD E. LOUIS, JR.[2,4]

[1]Anthropology, The Ohio State University, [2]Madagascar Biodiversity Partnership, [3]University Libraries, The Ohio State University, [4]Center for Conservation and Research, Omaha's Henry Doorly Zoo and Aquarium

Some primates will maintain a consistent home range size throughout the year, despite changes in resource availability. This behavior has yet to be witnessed in any lemur species. Aye-ayes have the largest home ranges of any lemur, ranging between 125-215ha (males) and 20-40ha (females) on Nosy Mangabe, and between 822-974ha for two males and 98ha for a single female in the disturbed forest of Kianjavato. There are no home range estimates for aye-ayes in a continuous forest over multiple seasons. We studied a male, Masy, and a female, Tsinjo, aye-aye in Torotorofotsy, Madagascar, from April 2014-December 2016 and July 2014-December 2016, respectively. We conducted six-hour night follows, collecting GPS points at every feeding and nesting site and every 15 minutes when the aye-aye was traveling. Because Masy often traveled beyond our permitted study area, we also included nesting sites where he was located during recollaring events. We used ArcGIS with Home Range Tools 2.0 add-in to estimate home ranges through the Minimum Convex Polygon (MCP) method with 100% of data points included. Tsinjo had an estimated home range between 808ha (MCP), while Masy's home range covered 1586ha (MCP). Tsinjo used most of her territory throughout the year, covering 65.8% of her home range during the hot-wet season, 83.4% during the cold-wet season, and 79.1% during the hot-dry season. Our findings indicate that aye-ayes maintain their large home range sizes throughout the year, despite seasonal shifts in resource availability.

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The Human Evolution Teaching Materials Project

MOLLY C. SELBA

Anthropology, University of Florida

The Human Evolution Teaching Materials Project (HETMP) was designed to provide middle school and high school teachers with the resources they need to incorporate human evolution into their existing curricula. HETMP provides learning objectives and student activities that take advantage of open-access 3D surface files of hominin crania (e.g., MorphoSource, AfricanFossils.org) to reinforce a student's understanding of evolutionary processes. Through a central website (www.hetmp.com), teachers have access to all these materials as well as constant graduate student support to facilitate their use in existing course content. The 2017 pilot program of HETMP included five (5) teaching modules that reference specific 3D models: *Australopithecus africanus, A. sediba*, *Paranthropus aethiopicus, P. boisei, Homo naledi, H. erectus, H. rudolfensis, H. habilis, H. heidelbergensis, H. sapiens,* and *H. neanderthalensis*. Teachers may choose to have students interact with the specimens using physical or digital models. Increased availability of 3D printers allow the models to be printed at the school or using a local 3D printer. Models may also be borrowed from an existing set of crania. Alternatively, 3D PDFs of each model are provided on the website and freely accessible in schools or at home using standard Internet browser software. The HETMP program not only highlights the importance of expanding open-source materials in anthropology, but also has a direct impact on evolution awareness among participants. HETMP is modular, scalable, and will be available to classrooms across the U.S., giving it the potential to impact thousands of pre-college students by demonstrating the tangible evidence of evolution.

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Odd-nosed monkey scapular morphology is convergent with hominoids and atelines

MICHAEL S. SELBY[1], C. OWEN LOVEJOY[2] and CRAIG D. BYRON[3]

[1]Department of Biomedical Sciences, Georgia Campus- Philadelphia College of Osteopathic Medicine, [2]Department of Anthropology and School of Biomedical Sciences, Kent State University, [3]Department of Biology, Mercer University

Reconstruction of hominoid locomotor evolution necessarily relies on analogies with extant taxa. Recent studies have shown that odd-nosed monkeys utilize more varied locomotor modes than other cercopithecoids, including below branch locomotion, and converge behaviorally with hominoids and atelines. Odd-nosed monkeys are more closely related to hominoids than atelines and also lack a prehensile tail, making them potential models for early hominoid locomotor behavior. Here, we test if locomotor behaviors of odd-nosed monkeys are reflected in their scapulae. Specifically, we test several ratios and angles that identify suspensory and clambering features, to see if odd-nosed monkeys (*Nasalis*, *Pygathrix*, and *Rhinopithecus*) are more similar to apes than other cercopithecoids. Principal components analysis separates taxa based on mediolateral breadth, and spine and glenoid orientation, with hominoids having positive loadings and cercopithecines negative. Atelines and odd-nosed monkeys are closer to hominoids, with cebines and other colobines intermediate. When each angle and ratio is considered individually, odd-nosed monkeys and *Piliocolobus* are consistently the closest taxa among cercopithecoids to, and often having overlapping values with, atelines and hominoids. Odd-nosed monkeys have glenoid angles comparable to *Alouatta* and *Lagothrix*, spine angles similar to *Pongo* and *Gorilla*, and mediolateral breadth ratios intermediate between hominoids and other colobines. These results show that odd-nosed monkeys are the most

similar among cercopithecoids to hominoid scapular morphology. They are convergent with, but less highly derived than *Ateles*, *Pan* and hylobatids. Furthermore, such convergence supports previous functional interpretations of hominoid scapular morphology as adaptations for suspensory and/or clambering locomotion.

Differential Enamel Thickness in the Anterior Dentition as a Signal for Gouging Behavior

KEEGAN R. SELIG[1], SERGI LÓPEZ-TORRES[2], ADAM HARTSTONE-ROSE[3], ANNE M. BURROWS[4] and MARY T. SILCOX[1]

[1]Department of Anthropology, University of Toronto Scarborough, [2]Roman Kozłowski Institute of Paleobiology, Polish Academy of Sciences, [3]Department of Biological Sciences, North Carolina State University, [4]Department of Physical Therapy, Duquense University

Exudativory poses unique dental challenges, since acquisition of exudates requires that the anterior teeth engage with a substrate that is often tougher than any components of the species' diet. Since enamel interacts directly with the substrate from which exudates are recovered, it could be predicted that patterns of enamel thickness may be influenced by that interaction. Examining patterns of enamel thickness in primates and other gouging mammals serves as an opportunity to better understand this dietary niche, and potentially test hypotheses about the dietary adaptations of fossil taxa.

Measurements of lingual and labial enamel thickness were taken on micro-CT scans for the anterior teeth of primates (n=13), bats (n=9), and marsupials (n=6), including both gouging and closely related non-gouging taxa. Tooth position examined was determined based on the part of the dental battery used during gouging.

Our results suggest that obligate gouging primates and marsupials are characterized by relatively thicker labial than lingual enamel, when compared to the relative enamel thicknesses of their non-obligate gouging or non-gouging kin. It is likely that this pattern of thick labial enamel and thin lingual enamel evolved to keep a sharp incisal edge on the tooth to better pierce the substrate, as lingual enamel wears away in life. Differential enamel distribution is also present in the canines of vampire bats, although in a pattern specific to their unique behaviors. Our findings suggest that enamel carries a signal for gouging and could be used to interpret feeding adaptations of extinct taxa.

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Modeling Domestication with Malagasy Lemurs

HANNAH SELVEY

Anthropology, University of Colorado Boulder

Captivity has the ability to drastically change a species, especially when captive enclosures and diets are not able to adequately reflect those of the wild. "Domestication" due to captivity in mammals is demonstrated behaviorally, through changes in life history, and through changes in skeletal morphology, such as include poorly developed cortical bone, skull thickening, palatal erosion limb bowing, and widening of certain aspects of the skull.

This research examines how differential environments, specifically diets, associated with captive settings may be evident in the cranial morphology of ring-tailed lemurs (*Lemur catta*) and Verreauxi's sifaka (*Propithecus verreauxi*). I demonstrate how, despite captive breeding efforts and enrichment programs to mimic wild settings, the pressures on lemurs may become evident in their cranial morphology: I compare the skulls of captive and wild lemurs. The seed pods of the kily tree (*Tamarindus indica*), found in lemur habitats in Madagascar, require excessive mechanical processing compared to captive diets that lemurs are given.

Cranial measurements related to mastication were taken and subjected to one-way tests, principal components analyses, and discriminant function analyses. Increased relative palate length was associated with captive *Lemur catta*, and the discriminant function analysis properly predicted 100% of captivity status with a training group of N=23. Understanding impacts of captive diet can not only help to improve husbandry efforts for endangered species, but can also be useful by informing scientists as to captivity associated nuances that may be associated with osteological materials housed within natural history collections.

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Anthroponotic transmission and evolution of *Staphylococccus aureus* in Green Vervet monkeys from The Gambia

MADIKAY SENGHORE[1,2], SION C. BAYLISS[3], BRENDA A. KWAMBANA-ADAMS[1], EBENEZER FOSTER-NYARKO[1], JAINABA MANNEH[1], MICHEL DIONE[1], HENRY BADJI[1], CHINELO EBRUKE[1], EMMA L. DOUGHTY[2], HARRY A. THORPE[3], ANNA J. JASINSKA[4], CHRISTOPHER A. SCHMITT[4], JENNIFER D. CRAMER[5], TRUDY R. TURNER[6,7], GEORGE WEINSTOCK[8], NELSON B. FREIMER[4], MARK J. PALLEN[2], EDWARD J. FEIL[3] and MARTIN ANTONIO[1,2,9]

[1]Vaccinology, Medical Research Council Unit The Gambia, [2]Microbiology and infection Unit, Warwick Medical School, University of Warwick, Coventry, UK, [3]Department of Biology and Biochemistry, University of Bath, Bath, UK, [4]Institute for Neuroscience and Human Behaviour, University of California Los Angeles, Los Angeles, USA, [5]School of Arts and Humanities, American Military University and American Public University, Charles Town, WVA, USA, [6]Department of Anthropology, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, USA, [7]Department of Genetics, University of the Free State, Bloemfontein, South Africa, [8]Genome Institute, Washington University, St. Louis, Missouri, USA, [9]Faculty of Infectious and Tropical Diseases, London School of Hygiene & Tropical Medicine, London, UK

Background: Staphylococcus aureus is a major human pathogen that colonises a wide range of species. In the Gambia Green Vervet monkeys come into close contact with humans creating opportunities for inter-host transmission of pathogens. Here we describe the evolution of *S. aureus* in Green Vervet monkeys in The Gambia and provide insights into its host adaptive mechanisms.

Methods: *S. aureus* was isolated from nasopharyngeal swabs that were collected from green vervet monkeys and whole genome sequencing was performed. A phylogenetic and pan genome analysis was performed alongside 59 human *S. aureus* context genomes and 20 global reference genomes. We used published mutation rates to date inter-species transmission.

Results: Our phylogeny was consistent with the clonal population structure of *S. aureus* wherein most monkey isolates formed a novel clade that was distinct from the human isolates. We noted evidence of both ancient and recent anthroponotic transmission of *S. aureus* to monkeys. In some cases there was evidence of onward transmission within the monkey population. Our data shows loss of important human colonisation factors such as panton-valentine leukocidin genes and immune evasion cluster genes in monkey isolates. There was no evidence of zoonotic transmission *S. aureus*.

Conclusion: We report a novel clade of *S. aureus* that emerged through an ancient anthroponotic transmission event and is dominant among monkeys in The Gambia. Our data shows that anthroponotic transmission of *S. aureus* to monkeys occurs and that it may be enhanced by gene loss.

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Reevaluating human skull variability in aboriginal population of Gran Canaria (Canary Island, Spain): A three-dimensional geometric morphometrics approach

ALEXIA SERRANO-RAMOS[1,2], JUAN MANUEL JIMÉNEZ-ARENAS[1,3,4] and JOSÉ ANTONIO ESQUIVEL-GUERRERO[1,2,3]

[1]Prehistory and Archaeology, University of Granada, [2]Archaeological 3D Modeling Lab, University of Granada, [3]Institute of Peace and Conflicts Research, University of Granada, [4]Department of Anthropology, University of Zürich

The study of the origin, chronology, and diversity of pre-conquest aboriginal populations in Gran Canaria island (Canary Islands, Spain) has been dominated by biased and *racial* interpretations of the bioarchaeological and cultural evidence available. Specifically, Fusté in the fifties and Schwidetzky in the sixties concluded that two different populations inhabited Gran Canaria island with different chronology and cultural practices. Notwithstanding the racist bias, the research on the CAS variability was abandoned without replies. We therefore propose to reevaluate the CAS variability of the Gran Canaria population using techniques of three-dimensional geometric morphometrics.For that aim, we digitized 86 skulls housed at El Museo Canario (Gran Canaria, Spain) and from seven different ancient burial sites. Cranial landmarks (N=54) were placed with Landmarks software and were then superimposed using Procrustes analysis in Morphologika2.2. Subsequently, Discriminant Function Analyses were carried out with SPSS.24. The results show that the Procrustes Coordinates classify accurately between individuals buried in *tumuli* and funerary caves (84.9%) and also between inhabitants of the inland and the coast (80.2%). Nevertheless the percentage of correct classification reduces for biogeographic SW/NE regions (72.1%). Although the statistical results shown here are partially coincident with those by Fusté and Schwidetzky, a cautionary note must be put on the interpretations about the CAS variability until complementary approaches (v.g. biogeochemical and genomic) are conducted.

Timing of development of the permanent mandibular dentition: new reference values from the Fels Longitudinal Study radiographic database

MAJA ŠEŠELJ[1,2], LYLE W. KONIGSBERG[3] and RICHARD J. SHERWOOD[4,5]

[1]Anthropology, Bryn Mawr College, [2]Community Health, Wright State University Boonshoft School of Medicine, [3]Anthropology, University of Illinois at Urbana-Champaign, [4]Integrative Anatomy, University of Missouri, [5]Pathology and Anatomical Sciences, University of Missouri

Estimating chronological age or assessing the rate of maturation in subadults is an important task in biological anthropology. One of the most reliable ways of doing this is by evaluating dental development, however, few dental formation chronologies include reference values for very young children. We present a new chronology of permanent mandibular canine and postcanine dental formation from birth through age 23 years, based on approximately 6,000 radiographs of 585 participants (284 female, 301 male) from the Fels Longitudinal Study, recorded between 1940 and 1982. Tooth mineralization was scored using the 14-stage system of Moorrees et al. (1963). We calculated mean ages for stage, mean ages of attainment using probit and logistic regression, and maturity scores adapted for age prediction.

Compared to the classic chronology of Moorrees, Fanning and Hunt (1963), partly based on Fels radiographs, early crown development stages occur at earlier ages, but roots develop at increasingly later ages in our sample. This discrepancy, coupled with previous reports of the Moorrees et al. chronology providing unusually young reference ages relative to other samples, suggests it should not be used for estimating chronological age. Our results are more similar to chronologies based on recent clinical samples, though relatively late ages of attainment of advanced root formation stages in our sample raise the possibility of a secular trend between the mid-20th century and today. We find that the tempo of dental development tends to be faster in girls, but more variable in boys. Variation increases throughout ontogeny for all teeth.

Hominin isotopic dietary niche breadth expansion during pliocene environmental change

CHALACHEW M. SEYOUM[1,2], JOHN ROWAN[1,2] and WILLIAM H. KIMBEL[1,2]

[1]Institute Of Human Origins, Arizona State University, [2]School of Human Evolution and Social Change, Arizona State University

Dietary breadth is an important aspect of the modern human adaptive suite, but why hominins expanded their dietary niche is unknown. Stable-carbon isotope data from early Pliocene hominins *Ardipithecus ramidus* and *Australopithecus anamensis* have narrow, C_3-dominated isotopic signatures. Conversely, mid-Pliocene *Au. afarensis* has a much wider isotopic distribution and consumed both C_3 and C_4 plants, indicating a transition to a broader dietary niche by ~ 3.5 Ma. We hypothesize that the shift in hominin dietary breadth by ~ 3.5 Ma was related to a transition to lower rainfall and more seasonal environments in which food resources were more patchily distributed both spatially and temporally. Ecometric estimates of mean annual precipitation and precipitation seasonality based on herbivore community hypsodonty were generated for four Pliocene sites (Aramis, Kanapoi, Laetoli, Hadar) to test this hypothesis. We show that *Ar. ramidus* and *Au. anamensis* lived in wetter environments (~1250-1350 mm/year) with less seasonal rainfall than *Au. afarensis* (~1050-1250 mm/year), although these differences are not statistically significant, likely due to small sample sizes. There are, however, significant temporal trends across these sites towards lower rainfall (r=-0.73, p=0.03) and higher rainfall seasonality (r=0.79, p=0.02) through time. Overall, our results suggest *Ar. ramidus* and *Au. anamensis* preferentially exploited habitats in which preferred food resources were likely available year-round, whereas *Au. afarensis* lived in more variable, seasonal environments in which preferred foods were available only part of the year. *Au. afarensis* likely expanded its dietary niche in less stable environments, as reflected in its wider isotopic niche breadth.

Primate use of forest fallows and Waiwai garden hunting in an indigenous reserve in Guyana

CHRISTOPHER A. SHAFFER[1], CHARAKURA YUKUMA[2], PHILLIP SUSE[2] and ELISHA MARAWANARU[2]

[1]Department of Anthropology, Grand Valley State University, [2]Masakenari Village, Konashen Indigenous District

Anthropogenic habitat change and subsistence hunting represent considerable threats to primate conservation throughout Amazonia. However, indigenous reserves, where indigenous groups often practice the traditional subsistence strategy of swidden agriculture combined with subsistence hunting, now represent more than 50% of the protected areas in the Amazon Basin. Understanding how primates respond to the habitat mosaics created by abandoned fallows of different ages and the associated "garden hunting" by humans is critical for successful conservation in indigenous reserves. We conducted line-transect surveys and calculated the catch-per-unit-effort (CPUE) of Waiwai hunters in a range of different habitat types in the Konashen Community Owned Conservation Area in Guyana to assess the effect of Waiwai subsistence agriculture and hunting on primate densities. We combined farmer interviews with supervised classification of Landsat satellite images to identify six classes of swidden fallows. We conducted line-transect surveys from June-August 2013, 2015, and 2016 to compare the densities of eight primate species across habitat types. We also used data collected by Waiwai hunters through a participatory self-monitoring program to determine encounter rates and CPUE for primates in each habitat. While primates were absent from the youngest fallows, several species, including important Waiwai prey species, exhibited similar densities in older fallows and undisturbed forest. CPUE in the oldest fallows was higher than in undisturbed forest. As large areas of forest in Amazonia consist of mosaic habitats created by

swidden agriculture, understanding how primate prey and human hunters interact in these areas is imperative for sustainable resource management and primate conservation.

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Post-Glacial and Neolithic Migrations Spread Rare HV lineages from Near East to Europe and South Asia

MICHEL SHAMOON-POUR[1,2], MIAN LI[3] and D. ANDREW MERRIWETHER[1,2]

[1]Department of Anthropology, Binghamton University, [2]Freshman Research Immersion (FRI), Binghamton University, [3]Department of Biology, Binghamton University

Haplogroup HV has a peculiar position in human mitochondrial phylogeny, as it comprises haplogroup H, the most common mtDNA clade in Europe. Due to significantly different phylogeographies of H and V from the rest of HV subclades, HV*(xH,V) lineages are usually studied as a separate haplogroup. Despite the higher frequency and diversity of HV*(xH,V) in the Near East and Caucasus, due to the small number of mitogenomes representing this region, previous studies of HV*(xH,V) mainly focused on the subclades present in Europe. Utilizing newly found non-European mitogenomes, this study aims to study these lineages from the perspective of the Near East and the Caucasus. 27 Assyrian mitogenomes first described here, were utilized along with 256 (103 non-European, and 153 European) previously published mitogenomes to reconstruct the phylogeny of HV*(xH,V) subclades. The phylogeny of HV*(xH,V) signals at the expansion of two distinct sets of subclades from South Caucasus and Iran into Europe and South Asia. HV*(xH,V) subclades shared between Italy and Near East characterize a Post-Glacial (HV1a1, HV1a2 HV1b) as well as a Neolithic (HV1b3, HV18) migratory event originated in South Caucasus or Zagros mountains. In accordance with recent ancient DNA findings, non-European HV12 and HV14 subclades characterize a pre-Neolithic or early Neolithic expansion of these haplogroups eastward of Iranian plateau. We also identified 16 new subclades within HV1, HV4, HV-16311, HV12 and HV18 haplogroups. Notably, our reconstruction of HV1b-152 subclades using Assyrian mitogenomes signals at the origin of Ashkenazi HV1b2 subclades in northern Mesopotamia and South Caucasus.

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A preliminary comparison of the variation in *Symphalangus syndactylus* iliac trabecular architecture between specimens of known and unknown origin

DARSHANA SHAPIRO

Anthropology, Center for Human Evolutionary Studies, Rutgers, The State University of New Jersey

It is often assumed that captive/zoo/data deficient specimens in museums differ morphologically from their wild conspecifics and should be excluded from analyses. Captive primates are neither kept in enclosures that recreate their natural habitats in size or substrate, nor are they able to range widely; however, previous work comparing the two groups has not found consistent differences in skeletal morphology. This project is a preliminary attempt to compare these groups via HRXCT of the lower ilium of six siamangs (four wild-shot, two lacking locality data). Trabecular bone spheres (21-30/ilium, total n = 159) were sampled to characterize the overall internal architecture, and bone volume fraction (BVTV) and degree of anisotropy (DA) were calculated. BVTV in the wild sample ranged from 0.092-0.461, while BVTV in the locality-lacking sample ranged from 0.042-0.388; generally BVTV in the wild sample was greater than 0.2, while the opposite was true of the other sample. One of the locality-lacking specimens had much higher DA than the wild specimens, while the other did not. Per bone functional adaptation, higher BVTV in the wild specimens suggests that their ilia experience greater stress than those of the other group. It is interesting that iliac trabeculae might be sensitive enough to signal this, given the forelimb-dominated locomotion of *Symphalangus*. This comparison indicates that additional work is needed to determine whether this variation is consistent between wild and captive specimens. If so, it may be possible to correct for it, allowing for increased sample sizes in future studies using museum collections.

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The behavioral costs of parasitism in female chacma baboons (*Papio ursinus*)

ERIC C. SHATTUCK[1], LARISSA SWEDELL[2,3] and STEFFEN FOERSTER[4]

[1]Anthropology, University of Texas at San Antonio, [2]Anthropology, Queens College, City University New York, [3]Archaeology, University of Cape Town, South Africa, [4]Evolutionary Anthropology, Duke University

Host behavioral changes during infection (i.e., sickness behavior), including lethargy, may be an adaptive means of reprioritizing energy expenditure and hastening recovery. However, other research suggests that sickness behavior is sensitive to several social and ecological factors, such as reproductive state or threats to dominance. Relatively little is known about non-human primate sickness behavior and its plasticity across reproductive cycles and seasons. Here, we assess whether infections with a common intestinal nematode, *Trichuris* sp., is associated with behavioral changes among female chacma baboons (*Papio ursinus*), and the extent to which such associations vary with reproductive state. The shedding of *Trichuris* eggs was quantified in 4,914 fecal samples collected from 30 individually recognized females in 2 troops inhabiting the Tokai Forest, Cape Town, South Africa, between August 2013 and June 2015. Behavior was assessed in 15 minute continuous focal samples for >5,000 hours of total observation time. Using general linear mixed effect (random slope and intercept) models, we found no significant association between *Trichuris* egg counts and behavior during pregnancy, lactation, or the luteal phase, controlling for season. During the follicular phase, the association between *Trichuris* burden and social behavior as well as activity levels varied by season. Our findings suggest that primates may modulate behavior in response to *Trichuris* infections, and that such changes vary by reproductive state and season, potentially reflecting differential energetic costs of immunity through the cycle. We discuss possible mediators of those effects, including variation in reproductive and stress hormones.

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Unique features of pelvic brim morphology and associated musculature in *Pongo*

BRIAN M. SHEARER[1,2,3], MAGDALENA MUCHLINSKI[4] and ASHLEY S. HAMMOND[5,6]

[1]Department of Anthropology, CUNY Graduate Center, [2]NYCEP, The American Museum of Natural History, [3]Department of Cell Biology, New York University Langone Medical Center, [4]Center for Anatomical Sciences, University of North Texas, [5]Center for Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, [6]Human Origins Program, Department of Anthropology, National Museum of Natural History, Smithsonian Institution

Orangutans typically exhibit a large, cranially-projecting tubercle on the superiolateral portion of the iliopubic region of the pelvis, which has historically been described as the pubic tubercle by researchers. However, it is not clear that this tubercle is homologous to the human pubic tubercle, as the soft tissue attachments and functional role for this feature in *Pongo* remain poorly understood. We conducted an osteological survey of pelvic brim morphology across 27 primate genera (n=208 specimens) to document the presence of this "iliopectineal" tubercle in other primate pelves, as well as to characterize its morphology. We then dissected orangutan and other ape cadaveric specimens to evaluate the

relationship among the tubercle and surrounding soft tissues. Our osteological survey confirms that the iliopectineal tubercle in orangutans is situated along the pectineal line, lateral to where the pubic tubercle in humans is found, and is consistently present in a strongly hypertrophied state in *Pongo* to the exclusion of all other primates. Cadaveric dissections revealed that the tubercle is associated with the proximal insertion of the adductor longus muscle tendon in orangutans. Other soft tissues (e.g., inguinal ligament, ventral abdominal wall musculature, psoas minor) were not found to be directly associated with this tubercle in the orangutan. Our dissections of the pelvic brim in other apes demonstrate that, while several muscles insert around the iliopectineal eminence, a cranially-projecting tubercle is consistently absent at the proximal attachment point of the adductor longus in non-pongine taxa. We propose functional and phylogenetic implications for this feature.

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Social cohesion varies by sex and forest zone among mantled howler monkeys (*Alouatta palliata*) in a Costa Rican forest fragment

ELIZABETH A. SHEEHAN[1,2], AMY L. SCHREIER[1,2], ZACHARY S. JACOBSON[2,3], DORIAN G. RUSSELL[2,4], MADISON L. AZZARA[2,5], RENATE M. SCHLAHT[1,2] and LAURA M. BOLT[2,6]

[1]Biology, Regis University, [2]Maderas Rainforest Conservancy, [3]Anthropology, Grand Valley University, [4]Environmental Science, American University, [5]Biology, James Madison University, [6]Anthropology, University of Toronto

Social cohesion – proximity among individuals – provides primates with better access to food resources. Little is known about how primate social cohesion varies by sex in different forest zones. Due to their higher energetic demands of reproduction, females should prioritize feeding more highly than males. Forest interior is expected to have higher food abundance than the edge. Therefore, we hypothesized that females would be more cohesive in the interior than the edge while male cohesion would not vary by forest zone. We tested this hypothesis in *Alouatta palliata* at the La Suerte Biological Research Station, a fragmented forest in Costa Rica. We recorded the number of individuals within 5m of focal subjects in the edge and interior at La Suerte from May-August 2017. We also conducted vegetation transects, calculating tree species richness and diameter at breast height (DBH). Mean tree species richness was significantly higher in the interior (6.1 trees/m^2) compared to the edge (3.8) and interior trees had greater DBH (34.1 cm) than edge trees (22.4 cm), showing greater food abundance in the interior. Furthermore, females were significantly more socially cohesive in the interior than the edge; on average, females had 5.23 neighbors within 5m in the interior and only 3.47 in the edge. Males' difference in social cohesion (4.47 neighbors within 5m in the interior and 3.57 in the edge) was not significant. These results suggest that females are disproportionately affected by their energetic demands and adjust their social cohesion in relation to food availability accordingly.

Spectral niche segregation in Sulawesian dawn and dusk choruses: the place of tarsiers and small mammals

MYRON SHEKELLE[1] and MAUD SCHULER[2]

[1]Anthropology, Western Washington University, [2]Ecophysiology and Ethology, University of Strasbourg

Ecologists often examine the concept of niche through spatial distribution, or sometimes temporal distribution (e.g. diurnal and nocturnal activity patterns), and then seek to understand how lifeforms segregate themselves among these niches. We examine a less commonly studied aspect of niche, the spectral niche, in which all acoustic communication occurs. The dawn and dusk choruses of tropical forests are busy times for those organisms that communicate acoustically, with dozens of species competing for limited spectral space. Temporal segregation, while possible, is limited owing to the relatively brief period of mesopic light conditions in the daily light-dark cycle in the tropics, during which choruses occur. It stands to reason that pronounced spectral segregation in the tropical dawn and dusk choruses is to be expected. Our results not only find this to be true, but also find a very deep phylogenetic component to spectral niche segregation. Most prominently, insects, primarily cicadas and crickets, produce very loud calls in a narrow band, 5-7 kH. Other animals segregate themselves almost completely, either above or below these bandwidths. During the chorus, bird calls are almost entirely below this band, whereas small mammals, including tarsiers, are almost exclusively above this band. The phylogenetic component to spectral niche segregation, combined with the broad distribution of ultrasonic communication among mammalian families, and the very small size of the most basal fossil primates, and even mammals, leads us to speculate whether one component of the fundamental primate niche, or possibly even the mammalian niche, is high frequency acoustic communication.

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Brain and Vascular Changes in Culturally Deformed Crania

TIFFANY W. SHIEN[1], PINA A. SIMONE[1], CORTNEY M. CONNOR[1], SIERRA MH. LEE[1], LILLY W. TANG[1], REBECCA S. JABBOUR[2] and GARY D. RICHARDS[3]

[1]Department of Molecular and Cell Biology, University of California, Berkeley, [2]Department of Biology, Saint Mary's College of California, [3]Biomedical Sciences, A.A. Dugoni School of Dentistry, University of the Pacific

Cranial shape modifications, whether intentional or unintentional, are well documented in archaeological and modern contexts. Whereas external shapes have been extensively studied, endocranial shape and associated brain and vascular impacts are less well studied. Follow-up studies of infants with one type of common shape change, positional plagiocephaly, have found developmental delays. Modifications to cranial blood flow may be a causative factor. We examine endocranial blood flow patterns in culturally deformed crania to document any changes and relate these to modifications in functional matrices.

Our sample comprises CT-scans of crania (deformed, *n*=5; normal, *n*=15) with developmental ages ranging from ≈5.0 years to adult. Endocranial surfaces (brain/vascular impressions) were segmented and visualized as surface meshes with Amira. Shape and anatomical deviations from normal brains were assessed by direct comparison and literature based observations of normal anatomy.

All affected individuals appear to have experienced cradle-boarding, but resulting cranial shape varied because of a pad on the cradleboard. Infant heads were inconsistently affixed to the padded board, moving the point of constraint to different occipitoparietal positions. These positional differences result in crania with occipitoparietal flattening and variably expressed superior and posterolateral shifting of cranial contents. Irrespective of the latter differences, all cases show similar modifications to the posterior sagittal, transverse, and sigmoid sinuses, with ballooning of portions of the transverse sinus. Jugular foramen restriction and increased emissary foramen size was also noted. These changes appear related to shifts in cranial contents and differ in some ways from those seen in positional plagiocephaly.

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Sacral Morphology of Prehensile-Tailed Primates in Relation to Biomechanical Loading

H. GRACE SHOWALTER

Anthropology, University of Arkansas

The few available comparative studies of prehensile tail anatomy in primates have established

that features of the caudal vertebrae are associated with adaptation to the increased loading of prehension. Given the degree of variation seen in the caudal vertebrae, there is reason to believe that sacral morphology should also vary with tail prehensility. Convergent evolution of prehension and clear variation in the use of tails raises questions not only of how sacral morphology differs between prehensile and non-prehensile taxa, but whether different taxa evolve the same solutions to the biomechanical demands of prehension. The first step in addressing these problems is to document and measure the anatomical correlates of prehension in the sacrum. Once such anatomical correlates, if they exist, are established, then questions of morphological adaptation to prehension can be asked.

A comparative study of primate sacra was completed among the following genera: *Alouatta, Ateles, Cebus, Chirpotes, Lagothrix, Macaca, Pithecia,* and *Saimiri* (total n = 103). The genera were split into fully, semi-, and non-prehensile groups; *Ateles* and *Lagothrix* were categorized as fully, *Cebus* and *Alouatta* as semi-, and the remainder as non-prehensile. Linear measurements for sixteen variables were collected using the Fowler Caliper Ultra-Cal Mark III. The data were transformed using a geometric mean to create Mosimann shape ratios to control for allometry. Initial analysis for variation between fully-, semi-, and non-prehensile taxa was completed with Mann-Whitney U tests. Of sixteen variables, all but three were significantly different, indicating that sacral morphology does vary with degree of prehension.

A Malignant Monkey: Skeletal evidence of metastasis in a Tantalus monkey (*Cercopithecus tantelus*)

THOMAS SIEK and CARA HIRST

Institute of Archaeology, University College London

Paleo-oncology is a relatively new sub-field of paleopathology, and is the study of neoplastic disease in antiquity. It is concerned with furthering our knowledge of a disease that is seen as uncommon or rare before the modern age. This is normally accomplished by investigating historical and archaeological materials, particularly human skeletal remains. However, zoopaleopathology, the study of disease in animal remains, has remained an untapped source, especially in regard to non-human primates. Skeletal malignancies in non-human primates are also considered to be rare, but this could be due to a lack of evidence and investigation. We present the skeletal remains of a Tantalus monkey (*Cercopithecus tantelus)* that displayed osteolytic lesions typical of a form of neoplasia. Our differential diagnosis of the osteolytic lesions is consistent with that of metastatic carcinoma. This case is significant as it adds to the scant literature regarding neoplastic disease in non-human primates and adds to a broader understanding of paleo-oncology, through zoopaleopathology.This study generates further information about neoplasia at a cross-species level and draws focus on the possible interaction of humans and non-human primates in captivity. It is hoped that this will stimulate more research into neoplasia and other diseases that are viewed to be related to modernity, human environment and life history.Furthermore, this paper argues for the re-examination of skeletal collections, specifically non-human primate collections, where palaeopathological examination may not have been conducted.

Enhancing craniofacial identification methods with CT data

TERRIE SIMMONS-EHRHARDT[1], CATYANA FALSETTI[2], ANTHONY B. FALSETTI[3] and CHRISTOPHER J. EHRHARDT[4]

[1]School of World Studies, Virginia Commonwealth University, [2]School of Geological Sciences and Urban Planning, Arizona State University, [3]School of Mathematics and Natural Sciences, Arizona State University, [4]Department of Forensic Science, Virginia Commonwealth University

Three-dimensional (3D) models generated from computed tomography (CT) scans from The Cancer Imaging Archives provide an opportunity to quantify relationships between the craniofacial skeleton and facial tissues via the placement of anatomical landmarks. Utilizing the 3D coordinates of orbitale, left and right porion, and nasion, we have rotated and translated the heads to a standard orientation and position referenced to Frankfurt Horizontal, so that distances and angles could be collected in any single axis (x-, y-, or z-) or view (frontal, profile) and to facilitate the translation of our data to 2D, 3D, or computerized facial approximation methods and craniofacial superimposition. We have used transformed landmark coordinates to quantify positional relationships between bone and skin landmarks (anterior/posterior, superior/inferior, medial/lateral), via signed distances in specific axes and angles calculated via trigonometric functions. We have also produced landmark/wireframe plots in frontal and profile views to illustrate these quantified bone to skin landmark relationships. Utilizing the free program Meshlab, we have developed an objective method for generating dense facial tissue depth maps (FTDMs) between the face and the skull. The 3D FTDMs are colorized from thinnest to thickest on an RGB scale. Corresponding mapped bone and skin points can be viewed simultaneously for the entire face or in 1 mm depth intervals. Our methods, 3D FTDMs, along with our original surface models, and landmark coordinates present a new reference dataset for craniofacial identification research and practitioner training and set a precedent for developing and standardizing such resources.

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Cranial shape change and developmental delays in plagiocephaly

PINA S. SIMONE

Molecular and Cell Biology, University of California, Berkeley, Biology, Saint Mary's College of California, Biomedical Sciences, A.A. Dugoni School of Dentistry

Rates of unintentional deformation of infant crania are increasing, with reported rates as high as 48% in healthy infants. This appears to be related to changes in infant sleeping positions driven by the 1992 "Back to Sleep" campaign to combat SIDS. Long term developmental outcome studies associate this condition, called positional plagiocephaly, with developmental delays, possibly driven by impaired blood flow. To document the type and extent of change associated with positional plagiocephaly, we describe changes in cranial shape, brain shape, and blood flow patterns.

We CT-scanned dry skulls with evidence of positional plagiocephaly (*n*=5) and a series of normal infant skulls (*n*=10, ages 1-4.7 y). Amira was used to assess skull asymmetry from isosurfaces and to examine the endocranium and vascular system from surface models.

All affected infants display the typical pattern of occipitoparietal flattening and also show deformation of the auditory, optic, and temporal functional matrices. The frontoparietal regions show a 'copper-beaten' appearance resulting from increased intracranial pressure induced by an anterolateral shifting of the brain. Further, blood flow would have been impacted by observed bone displacement. Restriction of the carotid arterial system and cranial venous sinuses is evident. However, although all affected individuals share same-side flattening, the side on which vascular outflow is restricted varies. Observed changes to blood flow may be related to reported developmental delays; it is also possible the degree of asymmetry imposed on cranial functional matrices is of equal or greater influence.

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Comparing rates of linage diversification with rates of size and shape evolution in catarrhine crania

EVAN A. SIMONS[1], STEPHEN R. FROST[1], KATERINA HARVATI[3], KIERAN MCNULTY[2] and MICHELLE SINGLETON[4]

[1]Anthropology, University of Oregon, [2]Evolutionary Anthropology Laboratory, University of Minnesota,

[3]Early Prehistory and Quaternary Ecology, Eberhard Karls Universität, Tübingen, [4]Anatomy, Chicago College of Osteopathic Medicine, Midwestern University

We used phylogeny based approaches to examine the relationship between rates of species diversification, rates of cranial size and shape evolution, and observed cranial morphological disparity of extant taxa. As many evolutionary hypotheses imply an association among these variables, it is important to empirically test if such a relationship exists.

Thirty-four 3D landmarks, digitized from 2,039 crania representing 42 catarrhine species, were superimposed using generalized Procrustes analysis. Consensus shapes and LnCS were obtained for each species. These species were then sorted into eight clades (Hominidae; Hylobatidae; Colobini; Presbytini; Cercopithecini; Macacina; P/L/T; and M/C clades). In conjunction with a time-calibrated molecular phylogeny, the consensus configurations were used to determine the rates of evolution of cranial size and shape by clade, using a Brownian Motion model. Rates of lineage diversification were calculated with a method-of-moments estimator. Morphological disparity was computed as the clade-wise Procrustes variance (using species means). These variables were then compared using regression.

We found a single significant relationship between rates of shape evolution and morphological disparity (adj. r^2 = 0.87; $F_{1,6}$ = 47.45; p=0.00046), both of which were greatest in hominids. Because of this, we hypothesized that *Homo sapiens* was largely driving this result. Therefore, we reran the analyses without *Homo sapiens* and found only a significant relationship between evolutionary rates of size and shape change (adj. r^2 = 0.57; $F_{1,6}$ = 10.31; p=0.018). This suggests that 'size as a line of least evolutionary resistance' may apply to catarrhine cranial evolution, except for *Homo sapiens*.

Communities of care and violence: The argument for simultaneous consideration of these seemingly disparate concepts in prehistory

DIANA S. SIMPSON

Department of Anthropology, University of Nevada, Las Vegas

Although analysis of prehistoric violence no longer views the lives of individuals as a simple binary between total peace or outright war, recent studies often continue to overlook the behaviors that might be regarded as the antithesis of violence; the provision of care. Additionally, certain applications of the *bioarchaeology of care* have cited a lack of evidence of violence as evidence of care in the form of protection from harm, further emphasizing the division between violence and care. However, the results of the recent application of an altered *bioarchaeology of care* approach to a prehistoric Native American cemetery population from North Alabama, have revealed that care and violence should not be analyzed and interpreted separately. Multiple individuals from this study, despite demonstrating similarities relating to the presence of antemortem and perimortem violent injury, were proven to be different only through the incorporation of the results of this care analysis into final interpretations.

In particular, it was only through this simultaneous analysis of violence and care, at the individual and population level, that this study was able to identify the earliest archaeological case of an argued "mercy killing" in the Southeast, a practice which is well documented ethnohistorically. This suggests that perimortem violence in the past might not simply be proof of violent attack or warfare, and it is argued that future applications of this simultaneous considering violence and care within past groups could lend new insight into human behavior and the development of social complexity through time and space.

Postcranial fossils of *Ardipithecus ramidus* from Gona, Ethiopia

SCOTT W. SIMPSON[1], NAOMI E. LEVIN[2], JAY QUADE[3], MICHAEL J. ROGERS[4] and SILESHI SEMAW[5]

[1]Anatomy, Case Western Reserve University School of Medicine, [2]Earth & Environmental Sciences, University if Michigan, [3]Geosciences, University of Arizona, [4]Anthropology, Southern Connecticut State University, [5]Paleoanthropology, Centro Nacional de Investigación sobre la Evolución Humana; Stone Age Institute and CRAFT Research Center

The discovery of the 4.4 Ma hominin *Ardipithecus ramidus* revealed an unparalleled and unpredicted locomotor pattern that combined arboreal clambering and a form of terrestrial bipedality. To date, only those fossils from the Aramis, Ethiopia area have informed us about this taxon's locomotion. Here, we report on the postcranial remains attributed to *Ardipithecus ramidus* from the early Pliocene sediments of the Gona Project study area (Afar Regional State, Ethiopia). These ca. 4.6-4.3 Ma remains include isolated hand bones as well as fragmentary but well preserved elements of a single individual primarily representing the right and left lower limbs. While there is overlap in element composition with those from Aramis, significant areas (proximal femur, distal fibula, distal tibia, calcaneus) are represented solely by the Gona fossils. While we reinforce the original interpretation of *Ar. ramidus* bipedal locomotion (such as hip abduction and metatarsophalangeal dorsiflexion), we provide additional evidence of anatomical variation of the locomotor anatomy for this early species.

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Genetic determinants of brain size: *ASPM* coding variation is associated with brain morphology in chimpanzees

SHEEL V. SINGH[1], NICKY STAES[1], WILLIAM D. HOPKINS[2,3], STEVEN J. SHAPIRO[4], BRENDA J. BRADLEY[1] and CHET C. SHERWOOD[1]

[1]Center for the Advanced Study of Human Paleobiology, The George Washington University, [2]Neuroscience Institute and Language Research Center, Georgia State University, [3]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center, [4]Michael E. Keeling Center for Comparative Medicine and Research, University of Texas MD Anderson Cancer Center Bastrop, TX

Studying genetic mechanisms underlying primate brain morphology can provide insight into the evolution of human brain size and cognition. In humans, mutations in the gene coding for ASPM (Abnormal Spindle Microtubule Assembly) have been associated with Autosomal Recessive Primary Microcephaly (MCPH), which is defined by a significantly reduced brain volume and results in intellectual disability. Structural imaging of *ASPM* associated brain abnormalities typically reveals a reduction in volume and surface area of cerebral cortical regions except for hippocampus and surrounding medial temporal lobe structures. However, little is known regarding the effects of *ASPM* variation in other primates. In this study, we examined associations between *ASPM* coding variation and brain morphology in chimpanzees. We genotyped 311 chimpanzees using high-resolution melt analysis targeting an A/C SNP in exon 3 of *ASPM*, which changes an amino acid from a Glycine to a Valine (G588V). Genotype frequencies were in Hardy Weinberg equilibrium (X^2=1.07, df=1, p=0.30) with the ancestral A allele present at higher frequency (0.94). Using T1-weighted magnetic resonance imaging of brains, we measured total brain volume, grey and white matter volume, and cortical surface area in 279 chimpanzees. We found a significant association of genotype with cortical surface area (left X^2=7.90, df=1, p<0.01; right X^2=7.06, df=1, p<0.01) but not with the other measures. Furthermore, no significant association was found with scores on a cognitive test battery for a subset of 99 chimpanzees. These results are the first evidence showing that *ASPM* variation potentially plays a role in shaping brain morphology in nonhuman primates.

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A preliminary investigation into the effects of allomaternal caregiving on cognitive outcomes in infants aged 13-18 months living in Tucson, AZ

BRITT SINGLETARY

School of Anthropology, University of Arizona

Humans differ from other primates in our extensive expression of allomaternal care (AMC—care from someone other than the mother). While it is well known that AMC can provide energetic support to mothers and their growing infants, it is unknown whether AMC may also impact infant cognitive development. Considerable AMC creates opportunities for infants to interact with different signalers (e.g., nannies, daycare providers, and/or relatives), and a signal-rich environment may enhance infant brain development and cognitive skills. As part of a larger ongoing project, I have begun collecting data from infants aged 13-18 months in Tucson, Arizona to investigate the potential relationship between standardized clinical scores on the NCHS Motor and Social Development Scales and Pearson Clinical Bayley-III Screening Cognitive Sub-Test, and the number of allomaternal caregivers an infant has interacted with during the 60 days prior to assessment. For infants aged 13-15 months, cognitive scores show some increase with the number of allomaternal caregivers (MSD: N=7, SD=14.65, r=0.32; Bayley-III: N=5, SD=3.65, r=0.33). Conversely, for infants aged 16-18 months, these scores decrease with the number of allomaternal caregivers (MSD: N=10, SD=10.41, r=-0.51; Bayley-III: N=3, SD=1.15, r=-0.90). These conflicting results are likely a product of small sample size, as the variation in scores between included infants age 16-18 months was quite small. Alternatively, these results may suggest that AMC does not uniformly impact cognition, suggesting AMC may be more critical during earlier developmental stages rather than later ones. Future analyses across the entire study population (expected N=100) may clarify these results.

Support for this project received from UA's School of Anthropology, UA's Social and Behavioral Sciences Research Institute, UA's Graduate and Professional Student Council, and UA's Confluencenter for Creative Inquiry.

The impact of tetracycline presence on endogenous DNA yield in the Kulubnarti Nubians

KENDRA A. SIRAK[1] and JULIE A. MARGOLIS[2]

[1]Department of Anthropology, Emory University, [2]Department of Anthropology, The Ohio State University

Ancient DNA (aDNA) is providing new insights into the genetic composition of and relationship between the two socially-distinct Nubian populations of Early Christian Period Kulubnarti (550-800 C.E.). Currently, aDNA analysis requires the amplification of small amounts of endogenous DNA using the Polymerase Chain Reaction, or PCR. Like skeletal remains from other Nubian and select Egyptian sites, most of the remains from Kulubnarti contain tetracycline, an antibiotic secreted by *Streptomycetes* bacteria that are highly prevalent in Sudanese Nubian soils. Tetracycline was produced during the fermentation of grains and was most likely ingested by the Nubians and Egyptians through consumption of beer. As a protein-synthesis inhibitor, tetracycline reduces the efficacy of PCR amplification and decreases sequencing yields when extracted alongside DNA using phenol/chloroform extraction methods. However, the correlation between tetracycline presence and endogenous aDNA yield has not previously been explored when silica-based DNA extraction protocols are used.

To determine whether the presence of tetracycline in skeletal remains impacts endogenous DNA yield when silica-based extraction protocols are used, we compare the percentage of tetracycline-labeled bone area in rib and clavicle cross-sections with the percentage of endogenous DNA recovered from petrous bone for 30 individuals from Kulubnarti. In contrast to studies that use phenol/chloroform extraction methods, our results suggest that the amount of tetracycline-labeled bone is not correlated with endogenous DNA yield when silica-based DNA extraction methods are used (R^2 = 0.014, p = 0.94). We therefore recommend that any aDNA studies analyzing skeletal material containing tetracycline-labeled bone employ silica-based methods for DNA extraction.

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The potential of the Georgie Project (Portuguese Water Dog) for discerning genetic from extra-genetic influences in structural and material variations in anthropoid limb bones

JOHN G. SKEDROS[1], MADISON S. DOUTRE[1], MITCHELL D. PETERSON[1], DOUGLAS J. WEAVER[1], JAMES S. SMITH[1], KEVIN CHASE[2] and KARL G. LARK[2]

[1]Dept. of Orthopaedic Surgery, University of Utah, [2]Dept. of Biology, University of Utah

In human humeri, radii, second/ third metacarpals, femora, and tibiae, Jepsen and Schlecht found significant covariance between external size, volume, mineralization and stiffness that is not well explained by sexual /physical characteristics suggesting genetic > environmental factor influences. Genetic bases for these relationships have been examined in mice; genotype-specific differences account for variability in adult traits (cortical area, polar moment of inertia, and tissue mineral density). Because mice data do not mirror human between-sex differences, we commenced studying femora from the Georgie Project (http://www. georgieproject.com; Portuguese Water Dogs). At our institution DNA from over 1000 dogs has been studied for associations between quantitative trait loci and morphological variations. 30 femora were randomly picked (all: 6-17 years old, mean: 12.6). Measurements: cervico-diaphyseal angle, total bone and biomechanical lengths, head diameter, femoral-head offset length, diaphyseal sagittal bow, and proximal femoral anteversion. Transverse cross sections were analyzed for cortical area, total area, and second moments of area. Mineral content (%ash) was determined at 50% section quadrants. Mineralization and robustness variations are greater than expected, with cortical robustness (cortical area divided by total area) negatively correlated with age (r= -0.547, p=0.002). In females, cortical robustness and age were also negatively correlated (r= -0.545, p=0.024); correlations in males trended the same. Average ash correlated significantly/ positively with cortical robustness with suggestion of male/female differences. Large variations in our data is promising for study of the entire cohort and has clear potential for translation to anthropoid limb bones, including study of genetic linkages of bone microstructural characteristics.

Below the crown: examining interspecies variation in postcanine enamel thickness, EDJ, and root form in the *Paranthropus* clade

MATTHEW M. SKINNER[1,2], SHARA E. BAILEY[3], PHILIPP GUNZ[2], WILLIAM H. KIMBEL[4], ZERESENAY ALEMSEGED[5], LUCAS K. DELEZENE[6], COLIN MENTER[7], JACOPO MOGGI-CECCHI[8] and KORNELIUS KUPCZIK[9]

[1]School of Anthropology and Conservation, University of Kent, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [3]Center for the Study of Human Origins, New York University, [4]School of Human Evolution and Social Change, Arizona State University, [5]Organismal Biology and Anatomy, University of Chicago, [6]Department of Anthropology, University of Arkansas, [7]Centre for Anthropological Research, University of Johannesburg, [8]Department of Biology, University of Florence, [9]Max Planck Weizmann Center for Integrative Archaeology and Anthropology, Max Planck Institute for Evolutionary Anthropology

Although there is considerable evidence of shared craniodental morphology within the *Paranthropus* clade, microwear and isotopic studies suggest that this shared morphology may be linked to different dietary behaviour in eastern and southern Africa. Recently, it has been demonstrated that detailed morphological analyses of the internal structure of tooth crowns (specifically, enamel thickness, enamel-dentine junction morphology and root/pulp canal form), assessed using high resolution microtomography, can reveal previously undetected differences in tooth structure that can have systematic and functional implications.

In this study, we generate high-resolution surface models of the EDJ surface, external root surface, and pulp canal form of *Paranthropus* specimens from Kromdraai, Swartkrans, Drimolen, Koobi Fora, West Turkana, and the Omo. We assess enamel thickness in 2D mesial planes of section, root/canal form through an expanded qualitative typology for the hominin clade, and EDJ morphology through landmark-based 3D geometric morphometrics.

Our results indicate that 1) the generally accepted derived nature of *P. boisei* relative to *P. robustus* is matched by detailed morphological features of the crown (increased enamel thickness and very low dentine horns) and roots (increased root volumes and increasing distal pulp canal size); 2) there is evidence for population differences between sites preserving *P. robustus*; and 3) there is evidence at Gondolin (South Africa) for morphological similarity in molar form with *P. boisei* from Koobi Fora. The implications of these findings for the systematics, functional morphology, and paleogeography of *Paranthropus* are discussed.

Quantifying the effects of indirect fire exposure to human skeletal remains at Çatalhöyük

CASSIE E. SKIPPER[1], SCOTT D. HADDOW[2] and MARIN A. PILLOUD[1]

[1]Department of Anthropology, University of Nevada, Reno, [2]ANAMED, Koç University

While cases of human skeletal remains exposed to direct heat are abundantly demonstrated in both modern and archaeological contexts, evidence of indirectly burned remains in the literature is scarce. Bodies subject to indirect fire pose many intriguing questions, including heat exposure patterns, temperature variables, thickness and type of material(s) through which the fire originated and burned, and possible causes and duration of the fire.

This case study examines the range of heat damage to human skeletons recovered at the Neolithic site of Çatalhöyük, Turkey (7100 - 5950 cal BCE). This archaeological site in central Anatolia is situated at an important stage in the development of early settled life, society, and domestication. At Çatalhöyük, individuals were typically buried under the floors of houses, and it was not uncommon for homes to be intentionally burned at the end of their occupation. This practice caused indirect thermal damage to the skeletons interred within, creating a unique taphonomic signature. This study presents evidence of the condition of the burned remains, including preservation of skeletal and brain tissue and analysis of burn patterns. Initial analyses of color quantification indicate there is a range of burning temperatures evidenced in the Çatalhöyük remains, with multiple levels of charring predominating over calcination. These temperature ranges and their resulting effects on human bone are further described and quantified.

This study serves to increase our understanding of indirect thermal damage on human remains as well as various social behaviors at Çatalhöyük.

A preliminary reconstruction of the paleocological context of Galili, Ethiopia using bovid dental metrics

AMANDA SLOTTER[1,2] and SCOTT W. SIMPSON[3]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Institute of Human Origins, Arizona State University, [3]Department of Anatomy, Case Western Reserve University School of Medicine

Paleoanthropological and geological field research at Galili, Afar Regional State, Ethiopia was reinitiated in 2016. The site has been established as encompassing sediments ranging between 2.5-4.5± Ma and includes early *Australopithecus* and perhaps *Ardipithecus*. While preliminary paleoenvironmental analyses have suggested open woodland to bushland-woodland and shrubland, we present here additional evidence of the diet and functional anatomy of the Early Pliocene bovids from Galili. Fossil bovids have been recognized as a crucial tool in understanding ancient environments and serve as an important ecological indicator. Establishing the habitats of Galili is important for both understanding the environment in which the fauna, including hominins, resided and providing comparison to other contemporaneous sites.

Taxonomic identification and metric analyses were performed on bovid teeth (n=93) from the 3.9-4.4 Ma Shabeley Laag and Dhidinley members to reconstruct the paleoenvironment. The sample was dominated by Reduncini, a riparian-associated tribe, and Tragelaphini, a browsing-associated tribe. Hypsodonty index was calculated for each tribe and results suggest the most abundant bovid taxa trend towards the brachydont category. Only three tribes: Alcelaphini, Antilopini, and Hippotragini fell within the mesodont category, and no tribes had hypsodont indices. Mesowear analysis of the sample indicated high occlusal relief and rounded cusp shapes were most common. Taken together, our results indicate a trend in bovid diet towards mixed feeding and browsing at Galili.

We thank Prof. H Seidler and his team for allowing access to the fossils they collected.

Environmental correlates of community niche structure in extant cercopithecid primates

IRENE E. SMAIL

School of Human Evolution and Social Change, Arizona State University, Institute of Human Origins, Arizona State University

Cercopithecid primates are a diverse group found across a range of African and Asian environments today, often in sympatric communities. Previous analyses based on observed behaviors have indicated a climatic influence on overall primate community niche structure. This study utilizes dental morphology to species to examine the relationship of climatic factors to ecomorphological niches. Additionally, development of a hard-tissue based analysis will permit comparable future studies of fossil cercopithecid communities.

Incisor, premolar, and molar metrics were collected from wild-shot museum specimens (n = 885). These included variables individually correlated with aspects of resource exploitation. Principal components analysis was performed on size-scaled variables, and components were then used to calculate multi-dimensional dental niche volumes and centroid positions. Locality information was used to assign individuals to communities of >3 species (n > 40). Where necessary, communities were supplemented with population averages. Temperature, precipitation, and seasonality data for each locality were extracted from the WorldClim database.

Preliminary results indicate no strong climatic effects on cercopithecid community dental niche structure. Instead, African and Asian communities occupy similar niche positions and relative niche volumes. Higher species richness in Africa does not necessarily correspond to greater niche volumes in these communities, likely due to dental morphological overlap across some species. These results complement previous studies indicating community overlap between African and Asian primate communities, and suggest that cercopithecid communities share common ecological niches despite their distinct biogeographic and adaptive histories. Future research will address whether fossil cercopithecid communities also occupied similar niches.

Sharp force trauma and ultraviolet radiation: The implications of environmental exposure on forensic cutmark analysis

JESSICA F. SMALL and CAROLYN RANDO

Institute of Archaeology, University College London

Sharp force trauma is a frequently observed skeletal injury resulting from armed interpersonal violence. Previous studies of UK crime indicate household knives are most commonly used in both fatal and non-fatal instances of sharp injury. However, it is currently unknown how environmental factors impacts the accurate reconstruction of linear sharp defects on bone. Specifically, the problem of bone surface destruction as skeletal material and trauma are exposed to ultraviolet radiation through weathering. In this study, analysis of experimentally inflicted cutmarks exposed to ultraviolet radiation

is undertaken to inform the study of sharp force trauma and forensic taphonomy.

Forty cutmarks were inflicted on domestic pig ulnae and radii, 20 made using a serrated blade and 20 by a non-serrated blade. Three observations of cutmarks were made: prior to UV exposure, after 252 hours, and after 504 hours of cumulative exposure. Results suggest width and depth measurements significantly altered after UV exposure (p=<0.05) and a significant increase in prevalence of cortical flaking was associated with exposure duration (p=<0.05). Discrimination between knife types was achieved when comparing width and cortical flaking occurrence (p=<0.05). These findings demonstrate that ultraviolet radiation incites change in skeletal material after exposure, and there are differences in cutmark characteristics between similar household knives. Such data can be used to discriminate between knife class unhindered by ultraviolet radiation.

A developmental origins of infectious disease? Using incremental carbon and nitrogen isotope analysis to illuminate the role of age-at-weaning on infectious disease mortality

APRIL K. SMITH[1], LAURIE J. REITSEMA[1] and ANTONIO FORNACIARI[2]

[1]Anthropology, University of Georgia, [2]Paleopathology, Department of Translational Research on New Technologies in Medicine and Surgery, University of Pisa

The Developmental Origins of Adult Health and Disease focuses on how early childhood and in utero stress affect mortality from metabolic disorder. The role of early childhood stress in mortality from infectious disease is currently understudied. One of the earliest forms of nutritional stress occurs during weaning, and weaning too early or too late can be detrimental to the health of the infant. Using a bioarchaeological approach, this research investigates the effect of age-at-weaning and early childhood diet on the cholera mortality by analyzing 19th century cholera victims from rural Italy. Canines and bone fragments were taken from individuals from two cholera cemeteries in rural Tuscany and Sicily, and two contemporaneous comparative skeletal collections. Each tooth was cut into 1.5 – 2 mm increments, and carbon and nitrogen isotope analysis was used to reconstruct diet and estimate age-at-weaning. Bone collagen was used to reconstruct the adult diet. Weaning patterns and dietary trends were compared between cholera victims and their contemporaneous populations to establish if age-at-weaning and diet differed between these populations. The results of this analysis indicate that weaning patterns varied between individuals and populations.

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Use of Laser Scanning Confocal Microscopy to Detect Diagenetic Changes in Bone

ASHLEY C. SMITH[1] and LELIA WATAMANIUK[2]

[1]Anthropology, University of Toronto, [2]Anthropology, McMaster University

When conducting a histological analysis of archaeological bone, one aspect that must be taken into consideration is the differentiation of diagenetic alterations from bone development. The purpose of the present research is to demonstrate a novel method of mapping diagenetic mineral alterations in bone using laser scanning confocal microscopy (LSCM). Thirty-two iliac and costal histological samples were stained with toluidine blue; 16 of the samples were clinical, taken from biopsy, while 16 were from a 5th – 2nd Century BCE Apollonian site. Imaging was completed using a Carl Zeiss™ LSM 800 LSCM with Airy-Scan®, utilizing 4 pre-set lasers: 405nm DAPI, 488nm, 543nm, and 633nm; and compared with white and polarized light images generated from a Keyence VHX2000 Digital Microscope. LSCM images were taken at 10x, 20x, and 40x magnification, using both z-stack and tile-image settings to generate a three-dimensional model encompassing a cortical section. Results were measured using qualitative variation as well as quantitative histomorphometric calculations. The results of this study found strong qualitative variation between the clinical and the Apollonian samples. All samples registered on the 543nm and 633nm wavelengths, while the Apollonian samples also had localized registration on the 405nm and 488nm wavelengths. Further, this registration occurred on or near the periosteal surface. No registration of these wavelengths was seen in the clinical samples. Comparisons with unstained samples suggests that the variation in registration is due to mineral reaction with the toluidine blue. The results of this method demonstrate an additional way to map diagenetic changes in bone.

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A Walk Through Time: Reconstructing A Holocene Footprint From Central Alaska

GERAD M. SMITH[1], TED PARSONS[2], EDDIE T. PEREZ[2], TYLER J. TEESE[2] and RYAN P. HARROD[2]

[1]Anthropology, University of Alaska Fairbanks, [2]Anthropology, University of Alaska Anchorage

In 2017, a feature resembling a shod human footprint was excavated in buried loess directly associated with a housepit feature at the Swan Point archaeological site in central Alaska (~1850 calBP). Recovery of ancient footprints is rare as they are generally destroyed by taphonomic processes. The purpose of this study was to test if the feature's morphometrics fell within the mean biometrics of a shod human footprint. 3D models of the impression were created in field using photogrammetric modeling and plaster casting. In the laboratory, the cast was modeled using a NextEngine desktop laser scanner, and the recovered feature was photographed in a controlled setting. The models produced by all three techniques were compared and found to be consistent. The primary literature on footprints focuses on barefoot patterns and shod prints with modern foot wear. This print appears to have been made by a foot shod in a moccasin. To test this, we photomodeled a worn-through historic moccasin. The shape and wear pattern of the moccasin matched the print and the depression pattern. A classic human foot landmark analysis suggests that the midfoot to heal was in the range of a foot this size. Recent research in the biomedical field has found that it is possible to reconstruct foot pressure using 3D models. We used differences in depth to locate the midfoot, lateral foot, and heal contact areas. Results suggest that the feature falls within the expected mean parameters of a shod prehistoric human footprint, the first described from Alaska.

Oral Health and the Eastern Agricultural Complex in the Kentucky Lake Reservoir, Tennessee

MARIA O. SMITH[1] and TRACY K. BETSINGER[2]

[1]Sociology and Anthropology, Illinois State University, [2]Anthropology, State University of New York, Oneonta

In the absence of consistent oral hygiene, the inevitable consequence of the progressive demineralization of dental enamel by carious lesions is penetration into the dentin and, eventually, pulp exposure, which signals the death of the tooth. For intensive agriculturalists, the consistent pattern of a ten-plus percent frequency of carious individuals in late prehistoric (Mississippian Period, AD 1000-1500) skeletal samples from North America flags the consumption of the cariogenic carbohydrate, maize. Indeed, caries has often been used to identify maize cultivation when archaeological context is lacking. The subsistence pattern of Mississippian period populations in what is now the Kentucky Lake Reservoir of west-central Tennessee lacks a well-documented archaeological context. The presence of caries should corroborate the temporal expectation of maize cultivation. Five site samples (Link, Slayden, Hobbs, Thompson, and Patterson) were examined for caries and pulp exposure. The frequency of caries in the sites falls between one and five percent suggesting non maize cultigens (Eastern Agricultural Complex). However, there is a heterogeneous pattern of oral decay with some sites exhibiting the full range of the carious demineralization process (e.g., occlusal pit/fissure caries, cervical caries, penetration of the dentin) while others exhibit pulp exposure in the absence of earlier demineralization stages (arguably caused

by crown breakage). A meta-analysis of tooth crowns by location and extent of oral decay indicates that the sites vary in their adoption of maize, a conclusion consistent with mortuary variability in the Kentucky Lake Reservoir providing stronger evidence of socio-cultural heterogeneity.

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Utilizing the bioarchaeology of care in the Lower Illinois River Valley

NICHOLAS SMITH[1], JANE BUIKSTRA[2] and ALIYA HOFF[2]

[1]Ecology, Evolution, and Environmental Biology, Columbia University, [2]School of Human Evolution and Social Change, Arizona State University

The bioarchaeology of care is a new approach for analyzing the remains of past individuals to glean information about their lives and those of their care-givers. The method first describes pathological conditions, engages in a differential diagnosis, and then interprets that information through the bioarchaeology of care model, which coincides with the form of care required and what that care would mean for the receiver of care and caregiver alike. This research analyzes the remains of two individuals from different Lower Illinois River Valley (LIV) archaeological sites: Ledders, dating to the Late Woodland period, and Koster, dating to the Early Archaic period. The two cases described here include a probable male who died in middle-to-late adulthood with ankylosing spondylitis (AS) and a possible male between the ages of 25-34 years of age with a possible form of osteomyelitis that affected the right tibia and fibula. Both pathologies would have inhibited mobility and required general care from the community in the form of resource provision and help moving around their given environments. The individual presenting with AS would have most likely needed care over the span of decades during the more-sedentary Late Woodland period, while the possible male with osteomyelitis would have required care for 3-6 months during the Early Archaic period. While the bioarchaeology of care method helped facilitate new ways of thinking about the lives of these two individuals, it is challenging to develop notions of social ideas around care and how impairment was perceived in these given contexts.

LINE-1 Methylation in Ancient DNA Reflects Sociopolitical Transformation in Peru

RICK W. A. SMITH[1,2,3], SANA SABOOWALA[3], AMY NON[4], TIFFINY TUNG[5] and DEBORAH A. BOLNICK[3,6]

[1]Neukom Institute for Computational Science, Dartmouth College, [2]Anthropology, Dartmouth College, [3]Anthropology, University of Texas at Austin, [4]Anthropology, University of California, San Diego, [5]Anthropology, Vanderbilt University, [6]Population Research Center, University of Texas at Austin

In recent years, researchers have shown that cytosine methylation patterns can be recovered from ancient DNA (aDNA). Because changes in cytosine methylation can be shaped by lived experiences, such as diet and exposure to violence, reconstructing methylation patterns in aDNA may provide insights into past lifeways. However, no study to date has assessed whether cytosine methylation patterns reflect differences in lived experiences that have been observed between archaeological populations. In this study, we applied recent developments in the field of paleoepigenetics to address archaeologically-informed questions about the reign and decline of the Wari, the first expansive state in South America. Bioarchaeological research in the Wari heartland has indicated significant changes in certain aspects of diet and a significant increase in violent trauma from Wari to post-Wari times. To assess whether cytosine methylation patterns differ across the Wari to post-Wari transition, we obtained dental and skeletal samples (n=33) from three archaeological populations: Wari (ca. 800 CE), Terminal Wari (ca. 1050 CE), and post-Wari (ca. 1300 CE). We extracted aDNA and analyzed a portion of the first hypervariable region of the mitochondrial genome to confirm the presence of endogenous DNA. We then used bisulfite pyrosequencing to analyze the methylation of four CpG sites in the promoter region of long interspersed nuclear elements (LINE-1). We found statistically significant decreases in LINE-1 methylation from Wari to post-Wari times ($p=0.03$), providing the first evidence that methylation patterns may reflect sociopolitical change in the ancient world.

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Texas museum displays of human evolution

SHELLEY L. SMITH

Sociology and Anthropology, University of Texas at Arlington

Outside of classrooms, the physical spaces in which people are most likely to encounter human evolution content are museum exhibits, thus making such exhibits critical to public education. Displays may be influenced by economic, historical, religious, and political forces; some reveal key theoretical debates. As part of a larger project examining exhibits in 11 museums, data were collected from 4 museums in Texas. Methodology is qualitative, involving a detailed analysis of text, visual presentation / artwork, use of space, and "edutainment." The Perot Museum of Nature and Science in Dallas can be described as "new and improving." Initially containing very limited human evolution content, a close association with Lee Berger and demonstrable public interest has stimulated exhibit enhancement. At the Fort Worth Museum of Science and History, evolution content is missing, but perhaps less for ideological reasons than due to economics, perceived mission, and "niche partitioning" in the Dallas-Fort Worth metroplex. Human evolution content disappeared from the Texas Memorial Museum in Austin in the summer of 2017 due to the "Virus to Whale" exhibit age and present museum funding concerns. The Houston Museum of Natural Science has a comparatively excellent exhibit, but it contains oddities perhaps best attributed to lack of expert oversight. In summary, in the large metropolitan areas of Houston and Dallas, human evolution content is presented to the public in prominent natural science museums. While improvement is desirable, constraints appear to be more economic than ideological.

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Environmental variation and nursing history revealed by Sensitive High Resolution Ion Microprobe (SHRIMP) analyses of oxygen isotopes

TANYA M. SMITH[1,2], DANIEL R. GREEN[2,3], CHRISTINE AUSTIN[4], MANISH ARORA[4], RAINER GRÜN[1,5] and IAN S. WILLIAMS[5]

[1]Australian Research Centre for Human Evolution, Griffith University, [2]Department of Human Evolutionary Biology, Harvard University, [3]Mineralized Tissue Biology, Forsyth Institute, [4]The Senator Frank R. Lautenberg Environmental Health Sciences Laboratory, Department of Environmental Medicine and Public Health, Icahn School of Medicine at Mount Sinai, [5]Research School of Earth Sciences, Australian National University

The oxygen isotopic composition of water varies with temperature and precipitation/evaporation cycles, and ^{18}O is enriched in mother's milk compared to drinking water. Oxygen isotope values in teeth therefore help paleoecologists reconstruct environmental changes, and bioarcheologists probe the timing of human weaning during prehistory. Tooth enamel is typically sampled by drilling to recover oxygen inputs from food and water consumed during tooth formation, as well as inspired air. This method has limited spatial resolution, yielding samples that integrate long formation times of unknown chronological age. Here were employ a Sensitive High Resolution Ion MicroProbe (SHRIMP SI) to measure oxygen isotope compositions ($\delta^{18}O$) on a spatial scale of 15–30 μm. Thin sections of wild orangutan, captive macaque, and captive sheep molars were sampled sequentially along the enamel-dentine junction using secondary-ion mass spectrometry. Standardized $\delta^{18}O$ values were related to temporal records of formation as well as calcium-normalized barium (Ba/Ca) values. We find that $\delta^{18}O$ values measured by SHRIMP SI are nearly identical to those from silver phosphate microprecipitation of diced

enamel from a sheep subject to an experimental water switch, confirming the fidelity of this approach for phosphate oxygen recovery. $\delta^{18}O$ values increased by 3‰ during a period of exclusive nursing in a macaque infant, consistent with reports of increases during human nursing. Finally we found that orangutan $\delta^{18}O$ values rose and fell in parallel with Ba/Ca values, adding further support to the hypothesis that orangutan nursing relates to fluctuating resource availability. This approach may be extended to well-preserved fossil material.

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Tooth crown volume of subadult primates: a methodology for measuring age-related changes

TIM D. SMITH[1,2], KELSEY A. PADDOCK[1], LARISSA M. ZEIGLER[1], RUSSELL T. HOGG[3], CHRISTOPHER J. VINYARD[4] and VALERIE B. DELEON[5]

[1]School of Physical Therapy, Slippery Rock University, [2]Department of Anthropology, University of Pittsburgh, [3]Department of Rehabilitation Sciences, Florida Gulf Coast University, [4]Department of Anatomy and Neurobiology, Northeast Ohio Medical University, [5]Department of Anthropology, University of Florida

Micro-computed tomography (μ-CT) has significantly increased knowledge on dental development, but challenges remain relating to the minute size and tissue composition of immature teeth. We studied two newborn primates (*Tarsius syrichta, Saimiri boliviensis*) to assess the ability of μ-CT to faithfully discriminate between dentin and enamel using the last deciduous premolar (dp4) and first permanent molar (M1) from each jaw. Enamel was frequently fragmented in histology of deciduous, but not permanent teeth. However, the dentin was pristinely preserved in histological sections, allowing a direct comparison. Thickness of the buccal cusps and marginal ridges was measured and compared between serial histological sections and CT slices prepared from the same specimens and aligned to the same viewing plane (n = 2 specimens; 4 teeth). There were no significant differences between histology- and μ-CT-derived measurements based on paired t-tests ($P > 0.05$). Our findings suggest some failure of μ-CT to detect isolated predentin, which tended to measure in thicknesses too small for our resolution to detect (20 to 30 μm voxels). However, the resulting deficit in crown volume was minimal (e.g., in the cervical region). This suggests μ-CT can be used to reliably reconstruct crown morphology in subadult primates. To apply our method, we analyzed crown volume of twelve species of mixed-age strepsirrhines (n=33; four anthropoids, eight strepsirrhines) from microCT data. Newborn *Propithecus* have the most fully formed dp4 and M1 crowns, measuring 80% or more of the volume observed in older infants (~one-month-old), and > 40% of the crown volume in weanlings.

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Distinguishing skeletal lesions of malaria from comorbidities and coexisting metabolic conditions at Amarna, Egypt

NICOLE E. SMITH-GUZMÁN[1], GRETCHEN R. DABBS[2], HEIDI S. DAVIS[3] and ASHLEY E. SHIDNER[3]

[1]Center for Tropical Paleoecology and Archaeology, Smithsonian Tropical Research Institute, [2]Department of Anthropology, Southern Illinois University, [3]Department of Anthropology, University of Arkansas

Several porous skeletal lesions have been implicated as sequelae from malarial infection. However, these lesions may also result from dietary deficiencies and health impacts from other infectious or metabolic diseases. Further complicating the differential diagnosis of causative factors leading to lesion formation is malaria's known predilection to co-infect with diseases such as tuberculosis and dysentery. How then might we distinguish between lesions caused by malaria infection directly and those caused by co-morbid conditions onto which malaria is "piggy-backing?" Here, we discuss these confounding factors in malaria diagnosis through macroscopic lesion analysis alone, using malaria's purported impact on ancient Amarna, Egypt as a case-study. Based on porous skeletal lesions previously implicated in malarial infection, the prevalence of the disease at Amarna's non-elite cemeteries is estimated around 57% at the South Tombs Cemetery, and 93% at the North Tombs Cemetery. In addition to individuals with specific nutritional deficiencies of scurvy and osteomalacia in the sample, at least one individual buried at Amarna showed signs of brucellosis infection. Complications involving the inability to do destructive analysis with the sample has forced innovative alternatives in the effort to disentangle potential comorbid conditions. The methods to be discussed include novel mathematical and algorithmic models adapted from clinical medicine and epidemiology.

Genetic diversity of color vision in four sympatric New World primates (*Ateles, Lagothrix, Pithecia, Plecturocebus*) at the Tiputini Biodiversity Station in Amazonian Ecuador

MAX SNODDERLY[1], CARRIE VEILLEUX[2,3], SHOJI KAWAMURA[4], EDUARDO FERNANDEZ-DUQUE[5], ANDRES LINK[6,7] and ANTHONY DI FIORE[3]

[1]Neuroscience, University of Texas at Austin, [2]Anthropology and Archaeology, University of Calgary, [3]Anthropology, University of Texas at Austin, [4]Integrated Biosciences, University of Tokyo, [5]Anthropology, Yale University, [6]Biological Sciences, Universidad de Los Andes, [7]School of Management, Universidad de Los Andes

In contrast to catarrhines, platyrrhines have substantial variation in color vision due to allelic variation at the X-linked *M/LWS* opsin gene. Although these variations have been extensively studied, little research has examined multiple platyrrhine species in the same environment. Here we report results from four sympatric primates (*Plecturocebus discolor*, *Pithecia aequatorialis*, *Ateles belzebuth*, and *Lagothrix lagotricha poeppigii*)at the Tiputini Biodiversity Station in Amazonian Ecuador. We sequenced exons three and five of the *M/LWS* gene in 16 *Plecturocebus* (8 females, 8 males, from 6 social groups), 9 *Pithecia* (4 females, 5 males, 4 groups), 21 *Ateles* (15 females, 6 males, 2 groups), and 21 *Lagothrix* (16 females, 5 males, 3 groups) and identified genotypes based on the sites known to influence spectral tuning of *M/LWS* opsins. For *Plecturocebus,* we identified three alleles (AFT, SYT, SFT) predicted to result in opsins maximally-sensitive to 545nm, 560nm, and 550nm, respectively, all of which have been found in other titi monkeys. However, the SFT allele, which appears rare in other titis, was relatively frequent in Tiputini *Plecturocebus* (~21% alleles). We also identified three alleles in *Pithecia* (AFA, AFT, SYT), encoding opsins predicted to be maximally-sensitive to 532nm, 545nm, and 560nm, respectively. For *Ateles* and *Lagothrix,* we identified two alleles (SYT, SFT) predicted to result in opsins maximally-sensitive to 553nm and 538 nm, respectively, both of which have been found in *Ateles geoffroyi* in Costa Rica. Future work will examine how this diversity of visual genotypes relates to comparative ecology and feeding behavior.

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A cross-cultural examination of the pathways of fertility decline across 45 countries

KRISTIN SNOPKOWSKI[1] and HEIDI COLLERAN[2]

[1]Anthropology, Boise State University, [2]Linguistic and Cultural Evolution, Max Planck Institute for the Science of Human History

Fertility decline remains a major evolutionary puzzle. While most previous research has only examined one (or a few) context(s), one would expect that as socioecologies vary, different factors may influence reproductive decisions. To fill this gap, we examined 45 countries undergoing fertility decline to answer two questions: is the effect of wealth and education on fertility outcomes consistent across countries and how do the pathways of fertility decline vary across countries? We use Demographic and Health

Surveys collected between 2003 and 2015, which include over 800,000 participants to examine these questions. Several possible mediators of the paths of both wealth and education on fertility outcomes are examined including: local mortality rates (a proxy for risk management), local birth rates (a proxy for cultural transmission), and women's labor-force participation. Our results show that the associations between wealth and fertility differ substantially across contexts, with wealth being positively correlated with fertility in the highest-fertility countries. In contrast, women's education has a consistent negative correlation with fertility outcomes. Our path analyses show that: local mortality rates do not significantly predict fertility outcomes in the vast majority of countries; women's labor force participation has a negative association with fertility outcomes in low-fertility countries, but the association varies dramatically in high-fertility countries; and local birth rates are positively correlated with fertility outcomes in every country examined. The similarities across countries suggest there are some common elements in reproductive decision-making, but the differences suggest that local socioecologies are important to understand demographic transitions across the world.

The Efficacy of 3D Models for Sex-Scoring Crania from Archaeological Contexts in Southern Peru

THOMAS J. SNYDER[1], SUSAN C. KUZMINSKY[2,3] and TIFFINY A. TUNG[1]

[1]Anthropology, Vanderbilt University, [2]Instituto de Investigaciones Arqueológicas y Museo, Universidad Católica del Norte, Chile, [3]Anthropology, University of California, Santa Cruz

This study compares the reliability of scoring sexually dimorphic cranial traits using digital 3D models versus observing the crania in person. The archaeological crania (N=45) are from the sites of La Real Beringa (600–1000 CE) and Quilcapampa (1000–1400 CE), all located in or near the Majes Valley in southern Peru. We compare the digital and in-person scores of the nuchal crest, mastoid process, supraorbital margin, and glabella. We also compared intra and inter-observer reliability a student and a professor to highlight the role experience plays in assigning cranial trait scores and estimating sex.

Cranial traits were ranked on a scale of 1 to 5, with 1 being most gracile and 5 the most robust, following Buikstra and Ubelaker (1994). Intraclass correlation coefficients (ICC) and Cohen's weighted kappas were used to test rater reliability. For scorer 1, an undergraduate with little experience in skeletal biology, ICC and Cohen's kappa showed acceptable agreement for the nuchal crest (.73,.39), low for mastoid processes (.53, .13) and supraorbital margin (0.34, .10), and good/moderate for glabella (.82, .53). For scorer 2, with 10 years of experience, nuchal crest (.91, .73), mastoid process (.87, 58), supra orbital margin (.88, .48), and glabella (.98, .92) ranged from excellent to moderate agreement . These data suggest that 3D models may be useful for estimating sex when the osteologist is experienced; however, they not be a viable replacement for students learning osteological techniques. The ability to palpate certain cranial features is crucial for students learning these methods.

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Testing a Novel Method of Metric Cranial Sex Estimation

TESSA SOMOGYI, ELIZABETH A. EVANGELOU, KORTNEY A. WILLIAMS, DANIELLE JULIEN, ANGELA FOLIGNO and ELIZABETH A. DIGANGI

Anthropology, Binghamton University

Sex estimation for adults is one of the major parts of the biological profile. Traditionally, sex estimation methods from the skull are based on visual assessment of discrete cranial features. However, a recent trend in forensic anthropology has preferred metric-based analyses due to their objectivity. Here, we test Casado (2017), a method that applies metrics to six sexually dimorphic cranial features. The sample analyzed in this study consists of 45 modern adult male and female crania that are primarily being studied for a project involving ballistic trauma. All individuals are between 55 and 95 years. The six cranial features were measured using coordinate calipers following the methods outlined by Casado (2017). While Casado (2017) excluded individuals with trauma to develop the method, the individuals here have been subjected to cranial trauma. Due to the nature of the remains recovered in forensic contexts, it is important to test novel methods on individuals that may have trauma or taphonomic damage. Preliminary data analysis suggests that this method can be used to reliably estimate sex on individuals presenting with traumatic damage. Using discriminant function analysis, 86.7% of the pilot sample were correctly classified. These results are consistent with those of Casado (2017) and are encouraging for future research involving metric sex estimation of the cranium.

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The shape of the hominin talus: Evolutionary timing and relationships of the talar facets

RITA SORRENTINO[1,2], CATERINA MINGHETTI[2], WILLIAM PARR[3], KEVIN TURLEY[4], STEPHEN WROE[5], COLIN SHAW[6], ANNE SU[7], LUCA FIORENZA[8,9], FRANCESCO FELETTI[10], TEA JASHASHVILI[11,12,13], STEPHEN FROST[4], KRISTIAN J. CARLSON[12,14], GIOVANNA M. BELCASTRO[1], TIMOTHY RYAN[15] and STEFANO BENAZZI[16,2]

[1]Dept. of Biological, Geological and Environmental Sciences, University of Bologna, [2]Dept. of Cultural Heritage, University of Bologna, [3]Surgical and Orthopaedic Research Laboratory, Prince of Wales Hospital, University of New South Wales, [4]Dept. of Anthropology, University of Oregon, [5]Computational Biomechanics Research Group, Zoology Division, School of Environmental and Rural Science,, University of New England, [6]PAVE Research Group, Dept. of Archaeology & Anthropology, University of Cambridge, [7]School of Health Sciences, Cleveland State University, [8]Dept. of Anatomy and Developmental Biology, Monash University, [9]Earth Sciences, University of New England, [10]Local Health Trust of Romagna, Dept. of Diagnostic Imaging, S.Maria delle Croci Hospital of Ravenna, [11]Molecular Imaging Center, Department of Radiology, Keck School of Medicine, University of Southern California, [12]Evolutionary Studies Institute, University of the Witwatersrand, [13]Department of Geology and Paleontology, Georgian National Museum, [14]Dept. of Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [15]Dept. of Anthropology and Center for Quantitative Imaging, Pennsylvania State University, [16]Dept. of Human Evolution, MPI-EVA

The human talus occupies a pivotal position between the leg and foot and is adapted to bipedal locomotion. Great debate surrounds interpretation of hominin talar functional morphology and influences of locomotor diversity. Here we analyze hominin whole talar morphology, using individual and combined talar facets to assess timing of the emergence of a human-like talus. A template of 251 (semi)landmarks was used to analyze 200 hominoid tali: 94 *H. sapiens*, 86 great apes, and 20 fossil hominins (*A. afarensis*, *A. sediba*, *P. robustus*, *H. habilis*, early *Homo*, *H. erectus* sensu lato, *H. floresiensis*, *H. neanderthalensis*). Digital reconstructions were used to estimate missing (semi)landmarks on partially damaged fossils with cracks and/or gaps. Incomplete tali were only analyzed for complete facets. Shape variation was evaluated through Generalized Procrustes superimposition and PCA. Talar shape separates *H. sapiens* from other apes, with australopiths plotting closer to great apes and all *Homo* fossils closer to modern humans. Analyses of individual facets showed the navicular facet to have the most discriminatory power, with other facets showing overlap in PCA scores within the extant sample. When combining articular surfaces, the combined head, trochlea and posterior calcaneal facet perform the best, clearly separating australopiths from *Homo*. Our results suggest that the relationship of talar facets is notable in recognizing a human-like talus, suggesting that to discriminate between groups the relative shape (size, orientation and position) of facets should be considered. This approach can contribute to the assignment

(taxonomic and functional) of fragmented fossil tali.

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Baby carrying positions change walking speed

OLUWADAMILOLA M. SOSANYA[1] and CARA M. WALL-SCHEFFLER[1,2]

[1]Department of Biology, Seattle Pacific University, [2]Department of Anthropology, University of Washington

Methods of infant carrying vary among different cultural groups, and potentially even within a group based on what other tasks the carrier is trying to accomplish. Here we investigate how the position of babies and toddlers influences aspects of the walkers' gait.

Kinematic measures and walking speed of adult male and female participants (n=6) were collected along a forested trail in the Pacific Northwest. Participants, while carrying their own infants (≤2 years), were asked to walk along a designated trail under three loaded conditions—front, back, and side—as well as without their infant in an unloaded control. Kinematic measurements, including stride length, were taken over a pre-measured portion of the route that included both flat and inclined terrain. Speed was collected across the entire path, as well as for the portions of the terrain where kinematics were monitored. Unsurprisingly, inclined terrain significantly reduced stride length (p=0.022), though interestingly, the babies' different positions did not initiate deviations from this general pattern. Baby carrying position did significantly change overall walking speed (p=0.031), in that front and side loading significantly slowed walking speed, whereas back carrying allowed participants to walk at speeds indistinguishable from their unloaded walking speed. Back carrying seemed particularly helpful in maintaining walking speed on the inclines, whereas on the level, back carrying decreased walking speed in a similar way to the other carrying conditions. This interaction did not quite reach significance (p=0.09) but deserves further attention.

Evaluating the appropriateness of the Maresh long bone data for age estimation of juvenile skeletal remains in forensic contexts

LAURE SPAKE and HUGO FV. CARDOSO

Archaeology, Simon Fraser University

In recent years, some have argued that the Maresh data is no longer appropriate for forensic use due to secular changes in growth. However, individuals who die in childhood, particularly homicide victims, tend to be of lower socioeconomic status, which is linked to delayed growth. Thus, children who become subjects of forensic anthropological evaluation are likely to be smaller for age than their peers. To evaluate the relevance of the Maresh data to recent forensically recovered juvenile remains, long bone lengths of the humerus, radius, femur, and tibia were gathered from 10 juveniles born between 1964 and 1994 included in the Forensic Data Bank (4 females and 4 males) and the Maxwell Museum (1 female and 1 male). Since ages were bimodally distributed, analysis was conducted for individuals ≤3 and ≥10 years of age. Individuals were compared to the Maresh long bone length 5th-95th percentile range using scatter plots and inclusion rates. All individuals fell within or below the 5th-95th percentiles, save for one ≥10 female individual. The ≤3 group all fell at or below the 50th percentile, with some individuals below the 5th percentile. The ≥10 group fell evenly above and below the 50th percentile and within the 5th-95th percentiles. In this group of children born as late as the 1990s, the Maresh data was still appropriate. Applicability to contemporary casework should be verified using more recent cases, however the Maresh data may still be relevant, particularly where younger (≤3 years of age) children are concerned.

Untangling the relationship between paleopathology and funerary behavior in the Italian Neolithic: new data from Arma dell'Aquila (Finale Ligure, Liguria region, northwestern Italy)

VITALE S. SPARACELLO[1], CHIARA PANELLI[2], STEFANO ROSSI[3,4], IRENE DORI[1,5], ALESSANDRA VARALLI[1], GWENAËLLE GOUDE[6], SACHA KACKI[1,7], CAROLINE PARTIOT[1], MARCELLO MANNINO[8], SAHRA TALAMO[9], MICHAEL P. RICHARDS[10,9], CHARLOTTE A. ROBERTS[7], JACOPO MOGGI-CECCHI[5], ELISABETTA STARNINI[3] and PAOLO BIAGI[11]

[1]UMR 5199 PACEA, Univ Bordeaux, [2]UMR 7264 CEPAM, Univ Côte d'Azur, [3]Archeologia Belle Arti e Paesaggio per la città metropolitana di Genova e le province di Imperia, La Spezia e Savona, Italy, Soprintendenza, [4]DISTAV, Univ Genova, [5]Dept. of Biology, Lab. of Anthropology, Univ Firenze, [6]UMR 7269 LAMPEA, Univ Aix Marseille, [7]Dept. of Archaeology, Durham University, [8]Dept. of Archeology and Heritage Studies, Aarhus University, [9]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, [10]Dept. of Anthropology, University of British Columbia, [11]Dept. of Asian and North African Studies, Univ Ca' Foscari Venezia

Numerous caves in the Finalese area (Liguria region, northwestern Italy) yielded some of the most important Neolithic sites in the Mediterranean, but it is unclear whether those were cemeteries, or places were only a sub-section of the population was buried. Excavations date back to the late 19th/early 20th centuries, resulting in poorly documented and chrono-culturally defined skeletal collections. Our reassessment of the nine burials from Arma dell'Aquila (excavated in the 1930s) dated one in a lithic cyst to 4730-4550 calBCE 2σ (Square-Mouth-Pottery chrono-cultural phase; SMP), five to an earlier phase (5360-4840 calBCE 2σ), and one to 5650-5540 calBCE 2σ, well within the Impresso-Cardial-complex timeframe. The scattered human remains yielded a MNI of nine additional individuals. The five burials are aligned NE-SW, crouched on the left side, without lithic cyst or grave goods, and oriented feet-against-feet, head-against-head. They constitute the earliest evidence of an apparently organized funerary space in the Neolithic of northern Italy. Two adults from this alignment show lesions suggestive of osteoarticular tuberculosis, and skeletal alterations (periostitis, arthritis, maxillary abscesses, cranial lesions) that are present in other individuals. This adds to the SMP burial, which was previously diagnosed with tuberculous spondylitis. Tuberculosis leaves skeletal traces in 2-5% of cases, and is rare in the archaeological record. Therefore, either the prevalence of this disease was exceptionally high throughout the Ligurian Neolithic, or selective burial practices may have been in place. The joint analysis of paleodemographic and paleopathological data in the Ligurian Neolithic offers a unique opportunity to untangle this issue.

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Parallel evolution of suspensory locomotion in tree sloths and implications for understanding homoplasy in hominoids

JEFF K. SPEAR[1,2] and SCOTT A. WILLIAMS[1,2]

[1]Department of Anthropology and the Center for Study of Human Origins, New York University, [2]New York Consortium in Evolutionary Primatology

Hominoids share many traits traditionally thought to be associated with forelimb dominated, suspensory locomotion, such as long arms and a modified shoulder joint. Many researchers now believe that at least some of these similarities are due to parallel evolution, based on previously unexpected mosaics of primitive and derived traits in fossil crown hominoids and the observation that suspensory atelines share many postcranial traits with hominoids. An independent comparative investigation of parallel evolution of suspensory adaptations in sister families unrelated to hominoids has not been previously attempted. To make this comparison, we used three-dimensional geometric morphometric and traditional analyses to examine convergence in the forelimb skeleton of sloths, which are thought to have independently developed inverted suspensory locomotion at least twice. Relative to their nearest living outgroup, sloths exhibited a mosaic of functional adaptations and

phylogenetically-retained features. The shape of the scapula of two-toed sloths is intermediate between those of three toed sloths and arboreal silky anteaters, whereas the humeri of the two and three toed sloths are distinct but overlapping, while the ulnae were almost indistinguishable in this analysis. These results suggest that expressions of parallel evolution may not be consistent across entire functional systems. Therefore hypotheses regarding parallel evolution in apes may be more usefully framed in terms of specific traits and functional attributes rather than broad adaptive complexes such as suspension.

High fat diet increases diet-induced thermogenesis in cold exposure and at thermoneutrality

TAYLOR M. SPENCER, AMY ROBBINS, CHRIS TOM, MIRANDA COSMAN, CLEO MOURSI and MAUREEN J. DEVLIN

Anthropology, University of Michigan

Diet induced thermogenesis (DIT) is the energy required to metabolize food, which generates heat. Protein requires the most energy and generates the most heat, and fats the least. Brown adipose tissue (BAT) is a site of DIT, as well as of overall nonshivering thermogenesis (NST) during cold exposure, but the relative effects of NST and DIT on body temperature are not well studied. This is an interesting question given that cold-dwelling humans have traditionally consumed high fat, high protein diets.

Here we test the effects of diet and temperature on NST and DIT in a mouse model. We predict that cold stress will increase NST and that high protein, high fat diet will increase DIT compared to a normal diet. Male C57Bl/6J mice were housed at 16°C and 26°C from 3-6 wks of age and fed either a high fat, high protein diet (HFHP) or a normal diet (N) (n=6/group). Outcome measures at 6 wks of age included food intake, maximum core body temperature (FLIR E-8, FLIR Systems), and UCP1 protein expression in BAT. Results indicate that cold mice ate more ($p<0.05$, GLM and Tukey test), but there were no differences between diets. Maximum core body temperatures were significantly higher at 16°C vs. 26°C ($p<0.05$). Within each temperature (16 and 26°C), maximum core body temperatures and UCP1 protein expression were higher in mice on HFHP vs. N diet ($p<0.05$ for all). These results demonstrate that high protein, high fat diet independently contributes to thermogenesis during cold exposure.

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Dental microwear texture analyses of the Paleoamerican of Lagoa Santa, Central Brazil

PAULO SPENGLER[1], PEDRO DA-GLORIA[1] and CHRISTOPHER W. SCHMIDT[2]

[1]Genetics and Evolutionary Biology, University of São Paulo, [2]Department of Anthropology, University of Indianapolis

Lagoa Santa, Central Brazil, is a karstic region where many ancient human skeletons have been excavated in the last 180 years. These skeletons date to between 11,000 and 7,000 ybp and consist of the largest sample of early Holocene hunter-gatherers in the Americas. In this work, we analyzed dental microwear of the Lagoa Santa collection using texture analysis (DMTA). We hypothesize that Lagoa Santa teeth will show a hunter-gatherer pattern characterized by a diet with little to no processing and high proportion of plants; but it also should have a difference in microwear between the sexes, based on previous analyses of dental pathological conditions in the collection. We studied permanent first molars casts of 23 individuals using a white-light confocal profiler. We targeted facet 9 and imported data clouds into two programs (Sfrax® and Toothfrax®), which use scale-sensitive fractal analysis to calculate three parameters: area-scale fractal complexity (Asfc), anisotropy (epLsar), and textural fill volume (Tfv). Even though females and subadults have a higher mean Asfc, the ANOVA results pointed to no differences regarding age (14 subadults; 9 adults; $p=0.28$) and sex (6 males; 3 females; $p=0.07$). The total Lagoa Santa sample showed mean Asfc values of 2.45, mean epLsar of 0.0029, and mean Tfv of 45101. These values are comparable to other hard food foragers in that the Asfc and Tfv are high and the epLsar is low; they confirm part of our hypothesis that the people of Lagoa Santa ate foods that were hard in nature and/or poorly processed.

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Stature estimation from fragments of the tibia in black South Africans

AMY J. SPIES[1], DESIRE BRITS[1] and MUBARAK A. BIDMOS[1,2]

[1]Department of Biological Anthropology, University of the Witwatersrand, [2]Department of Basic Medical Sciences, Qatar University

Intact long bones such as the femur and tibia have been shown to produce the most accurate estimates of stature and have been used in the derivation of regression equations in a number of populations. However, long bones are not always recovered intact and regression equations for fragments of bones are required. Since these equations are population specific, the aim of this study was to derive equations for stature estimation from tibial fragments in black South Africans. Two hundred complete skeletons were used (100 male and 100 female) from the Raymond A. Dart Collection of Human Skeletons. Total skeletal height (TSH) of each skeleton was measured using Fully's anatomical method and eleven variables representing tibial fragments were measured on each tibia. Univariate and multivariate regression equations were derived for the estimation of both TSH and tibial length (TL) from tibial measurements. All variables showed significant correlation to both TSH and TL ($p<0.05$). The range of standard errors of estimate for multivariate equations (3.43-5.06) was lower than that for univariate equations (4.23-5.66) and for those derived for white South Africans (5.20-6.71), but was slightly higher than those derived for intact tibiae (2.59-3.16). When intact tibiae are not available for analysis in forensic cases, the results of this study suggest that regression equations from fragments of the tibia can provide a reliable estimation of stature in black South Africans.

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Paranthropus paleoenvironments in South Africa

MATT SPONHEIMER[1], JENNIFER N. LEICHLITER[1], OLIVER C.C. PAINE[1], DARRYL J. DE RUITER[2] and JULIA A. LEE-THORP[3]

[1]Anthropology, CU Boulder, [2]Anthropology, Texas A&M University, [3]School of Archaeology, University of Oxford

Several decades of research in and around the Sterkfontein Valley has led to a consensus that *Paranthropus* inhabited more open environments than did antecedent *Australopithecus* species. This has been bolstered by dental microwear data showing that *Australopithecus* had wear patterns broadly similar to those of some extant apes, while some *Paranthropus* specimens show much greater evidence of pitting, suggesting consumption of harder foods (e.g., nuts, seeds). This is what might be expected in areas where the preferred foods of extant apes are at least seasonally scarce. Nevertheless, there have been hints over the years that this consensus is overly simplistic. For instance, the micromammalian assemblages at both *Australopithecus* and *Paranthropus* sites are dominated by similar taxa, and it has been further argued from the micromammals that all australopiths in the area experienced greater aridity than is found in the Sterkfontein Valley today. Moreover, a negative correlation between the abundance of *Paranthropus* and grassland macromammals, despite the ubiquity of the latter at robust australopith sites, might speak to unexpected complexities in habitat usage. In this talk, we attempt to synthesize the taxonomic, ecomorphological, isotopic, and wear evidence for *Paranthropus* environments in the Sterkfontein Valley. We also discuss the consequences of this

analysis in terms of resource availability/quality for robust australopiths and their coevals.

Phalangeriform marsupials as model taxa for early primates: Perspectives from dental topography and a revisit of Kay and Hylander (1978)

JACKSON P. SPRADLEY[1,2] and HANNAH E. PHILLIPS[2]

[1]Biology and Marine Biology, University of North Carolina- Wilmington, [2]Evolutionary Anthropology, Duke University

Among the many contributions of Rich Kay to primate functional morphology, his propensity for a comparative approach inspired subsequent researchers to study primate evolution in the wider context of mammalian evolution. In this study, we use the relatively novel metrics of dental topography (OPCR, DNE, and RFI) to compare prosimians to a group of ecologically similar mammals, i.e. the phalangeriform marsupials. Using 3D reconstructions of the lower M_2s of 32 species (16 phalangeriforms, 16 prosimians), we measured OPCR, DNE, and RFI on each tooth surface using the R package 'molaR'. All species were assigned one of three dietary categories traditionally recognized in prosimian primates: insectivory, folivory, or frugivory. Our results first suggest that all three dental topography metrics and diet are well correlated ($p < 0.001$) in both groups, corroborating previous studies. Using the Mann-Whitney-Wilcoxon test, we also determined that DNE and RFI have essentially equivalent values between prosimians and phalangeriforms when controlling for dietary grouping ($p > 0.05$). These results conform to the results of Kay and Hylander (1978), which found that shearing quotient was similar between the two groups when controlling for diet. However, the same test demonstrated that OPCR is consistently higher in phalangeriforms ($p < 0.001$). We speculate that this result may relate to the relative inflexibility of phalangeriform diets when compared to those of most prosimian primates. In general, the dentitions of phalangeriform marsupials would provide further evidence that they have potential as a model taxon for early primates.

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Environmental predictors of *Eulemur* pelage variation

AMANDA N. SPRIGGS[1,2], BRENDA J. BRADLEY[2], JASON M. KAMILAR[3,4] and ADAM D. GORDON[1]

[1]Anthropology, University at Albany-SUNY, [2]The Center for the Advanced Study of Human Paleobiology (CASHP), Anthropology, The George Washington University, [3]Anthropology, University of Massachusetts Amherst, [4]Graduate Program in Organismic and Evolutionary Biology, University of Massachusetts Amherst

In order to explore the evolutionary mechanisms maintaining primate pelage coloration, we investigate the relationship between pelage variation and evolutionary forces related to visibility. Lemuriforms vary in pelage coloration and habitat-specific light levels, forming a natural experiment for examining selection pressures on pelage coloration. Here we explore how *Eulemur* pelage coloration co-varies with habitat variables associated with visibility. Biome type, tree cover, and precipitation variables served as proxies for light level and background coloration. For 39 adult male and female *Eulemur* preserved skins (n = 10 species), pelage variation was quantified and compared with the Eigencoats methodology. The relationship between pelage variation and the independent variables was modeled with Phylogenetic Generalized Least Squares regressions. A canonical correlation analysis was used to investigate the relationship between pelage coloration and environmental variables associated with the amount of cover, light, and precipitation in *Eulemur* habitats based on museum-recorded provenance. Female *Eulemur* pelage coloration was significantly associated with body mass, biome, tree cover, annual rainfall, and annual numbers of dry months (alpha = 0.05). Canonical correlation analyses for both male and female members of *Eulemur* indicated a correlation between lighter, more countershaded coats and environments with less rainfall, more dry months, and less tree cover. Results suggest that in dense vegetative areas, it might not be as important to be countershaded as is it to have darker, inconspicuous pelage. As habitat light levels increase, it might then become important to lighten coats and ventral surfaces to match backgrounds or to use countershading to camouflage.

Data collection was funded through the NSF (BCS #1546730, BCS #1606360), the Wenner-Gren Foundation, and The George Washington University.

Continuity and aggregation at Mission Santa Catalina de Guale: Archaeological and genetic interpretations of regional population history in coastal Georgia

LAUREN C. SPRINGS[1], CLARK S. LARSEN[2], DAVID H. THOMAS[3], ANNA M. SEMON[3,4], ELLIOT H. BLAIR[5], NADIN ROHLAND[6], DAVID REICH[6,7,8] and DEBORAH A. BOLNICK[1,9]

[1]Department of Anthropology, The University of Texas at Austin, [2]Department of Anthropology, The Ohio State University, [3]Division of Anthropology, American Museum of Natural History, [4]Department of Anthropology, University of North Carolina at Chapel Hill, [5]Department of Anthropology, University of Alabama, [6]Department of Genetics, Harvard Medical School, [7]Broad Institute of Harvard and MIT, [8]Howard Hughes Medical Institute, [9]Population Research Center, The University of Texas at Austin

Numerous genetic inquiries have been undertaken to understand the peopling of the Americas, the subsequent genetic diversification of indigenous peoples, and the impact of European colonization on the established indigenous populations. In contrast, research illustrating fine-scale regional or local population histories in the Americas remains less common. In this study, we present results from archaeological and genetic analysis undertaken at St. Catherines Island, Georgia, to elucidate the changing genetic demography of local populations participating in Spanish mission systems during the sixteenth and seventeenth centuries.

The Guale at St. Catherines Island engaged the Spanish mission system during the colonial period, and archaeological research has illustrated the changing organization of the island's societies spanning the pre-mission and mission periods at the archaeological sites Fallen Tree and Mission Santa Catalina de Guale, respectively. We extracted ancient DNA from 94 individuals from the Fallen Tree (n=34) and Spanish Mission Santa Catalina de Guale (n=60) sites, and analyzed their genetic sequences to assess population changes over time. We have combined ancient mitogenome and genome-wide SNP analysis with archaeological interpretations to illustrate the breadth of genetic variation, degree of relatedness, and evidence for population continuity and regional aggregation in Guale populations on St. Catherines Island through time. Consistent with archaeological hypotheses and the ethnohistoric record, we have found evidence for population aggregation at Mission Santa Catalina de Guale in the form of gene flow from other populations, as well as for population continuity between the earlier Fallen Tree and later Mission Santa Catalina de Guale communities.

This study was funded by the National Science Foundation, the Edward John Noble Foundation, the St. Catherines Island Foundations, and the Howard Hughes Medical Institute.

Caste and Gender in South Asian History, circa 1450 to 1950

RAMYA SREENIVASAN

South Asia Studies, University of Pennsylvania

Historical accounts from early modern and modern South Asia reveal histories of socio-economic mobility that are at odds with normative ideologies of caste. This paper discusses the parallel histories of socio-economic mobility over the last five hundred years, and of ideologies of caste purity and pollution. The juxtaposition of multiple accounts of hierarchy and mobility can reveal both histories of diversity and of attempts to confront and comprehend it.

I will use my personal research funds for travel to and participation in the conference.

Biological and Cultural Influences on Caries Prevalence between Sexes among worldwide Skeletal Series

JULIANNE R. STAMER[1], KATHRYN MARKLEIN[1] and MARK HUBBE[1,2]

[1]Anthropology, The Ohio State University, Columbus, Ohio, 43210, [2]Instituto de Arqueología y Antropología, Universidad Católica del Norte, Chile

The global transition from hunter-gatherer to agricultural subsistence captures a profound biocultural transition in human history, resulting in significant changes to different aspects of human life-style, including the increased susceptibility to different pathological lesions, like dental caries. On a global scale, skeletal series show higher prevalence of caries in females than males. Biological (dental morphology, oral fauna, age, and sex) and cultural (diet, social/socioeconomic factors, technology, personal preference) variation have been argued to be responsible for this difference. However, the importance of these factors on caries prevalence between sexes is unknown. Here, we analyze the impact and importance of biological and cultural factors on caries prevalence by sex. Data on caries (prevalence by teeth and individuals) from 69 skeletal series from 55 sites published in *International Journal of Osteoarchaeology, Backbone of History, Current Anthropology,* and *American Journal of Physical Anthropology* were collected (N=4,374 individuals) and compared between sexes. Caries frequencies for males were plotted against the frequencies for females, and their relationship was analyzed through linear regression and ANOVA tests. The results show a strong association between sex and carious lesions (R^2 =0.187, p =0.015), with females showing 5.6% higher prevalence of caries than males, on average. However, this relationship explains a low proportion of the variance in the dataset, suggesting that the variation in caries prevalence is not due to intrinsic sexual differences. These results support the idea that caries has a complex etiology, and that differences between sexes cannot be easily attributed to either biological or cultural factors.

Using Machine Learning to predict locomotor behavior from femoral metaphyseal morphology in apes and humans

PETER A. STAMOS[1], ZERESENAY ALEMSEGED[2], ABHIJIT J. CHAUDHARI[3] and TIMOTHY D. WEAVER[1]

[1]Anthropology, University of California Davis, [2]Department of Organismal Biology and Anatomy, University of Chicago, [3]Department of Radiology, University of California Davis School of Medicine

The morphology of the metaphyseal surface of the distal femur differs significantly between juvenile apes and humans. This surface is relatively planar in humans, while in apes it is characterized by significant topographic complexity. Preuschoft and Tardieu (1996) suggested that the complex morphology in apes acts to protect the growth plate from stresses at the knee joint engendered by climbing and knuckle-walking.

We previously presented (Stamos et al., 2017) on how the femoral metaphysis is flat in both fetal humans and fetal chimpanzees, and only later in ontogeny does this morphology diverge between the taxa. This is consistent with the proposed developmental plasticity of this region of bone.

This study expands on our previous work by comparing the distal femoral metaphyseal surfaces in an ontogenetic series of humans and extant apes (n=180). We utilized a surface laser scanner to create three-dimensional models of femora, and then quantified metaphyseal shape using the Global Point Signature (GPS) method of shape decomposition. We trained a support vector machine (SVM), a supervised learning model from the field of Machine Learning, to classify locomotor behavior based on an individual's femoral metaphyseal morphology. The SVM permitted us to analyze the GPS shape variables, which because of their structure are incompatible with standard multivariate statistical methods.

Our model shows that the signature of different locomotor modes is captured faithfully in femoral metaphyseal morphology, suggesting that this region of bone will be highly useful for reconstructing the locomotor behavior of fossil hominins.

The Wenner-Gren Foundation University of California Davis

Head-to-head: A morphometric approach to cranial variation and island biogeography

SARAH STARK[1], CHRISTIANNE FERNÉE[2,3] and SONIA ZAKRZEWSKI[4]

[1]Archaeology, University of Southampton, [2]Archaeology and Anthropology, University of Bristol, [3]Archaeology, University of Southampton, [4]Archaeology, University of Southampton

This paper evaluates cranial morphology and the interaction of biogeographical variables from island groups in Oceania. Due to a lack of accessible techniques to analyze bone shape in the past, biogeographical patterning was difficult to assess. Through the use of 3D registration methods such as geometric morphometrics, such questions can now more easily be tackled.

This paper tests whether biogeographical variables, such as climate and altitude, affects cranial shape from nine island samples. The cranial samples were selected for their biogeographical variation in Oceania, and comprises Java (n=8), New Britain (n=34), New Zealand (n=26), Pagi (n=7), Papa New Guinea (n=6), Philippines (n=5), Solomon Island (n=3), Tagalog (n=8), and Australia (n=42). Each cranium was CT scanned with a Siemens Somatom Spiral scanner at a resolution of 0.5mm, at 70 μA and 110 kV. Geometric morphometrics was used to analyze and visualize cranial morphology between island groups and their relationship with climate (latitude) and altitude. Auto3dgm captured cranial shape data and a Procrustes (GPA) was used to analyze 300 pseudolandmarks for each crania.

Morphometric analysis revealed differences in cranial shape between island groups, climate and altitude. The facial region of the skull follows similar conclusions from studies addressing non-neutral patterns of variation. The face may be climatically driven and reflects patterns of past diversifying selection among the nine island groups. This paper demonstrates that in biogeographical studies, shape analyses has the potential to tease apart cranial morphology among island samples.

VCFtoTree: A user-friendly anthropological tool for constructing locus-specific alignments and phylogenies from genomic data

IZZY STARR, DUO XU and OMER GOKCUMEN

Biological Sciences, SUNY Buffalo

By analyzing specific loci in large genome sequencing studies, biological anthropologists can construct complete sequence alignments and phylogenies, allowing for novel insights into evolution and genetic variation. However, this is complicated without the necessary tools to integrate thousands of recently available and anthropologically relevant genome sequences used to construct complete sequence alignments and phylogenies. Here, we present VCFtoTree, a user-friendly tool that directly accesses online databases to download, parse, and analyze genome variation data for regions of interest. It combines popular VCF sequence datasets and tree building algorithms with custom data parsing to generate accurate alignments and phylogenies using all the individuals from the 1000 Genomes Project, and Neanderthal and Denisovan genomes, as well as Chimpanzee and Rhesus Macaque reference genomes. It can also be applied to other phased human genomes, as well as genomes from other species. It compares to other similar phylogenetic analysis tools, with notable improvements such as its user-friendly interface for a wider audience without prerequisite knowledge in programming, a one-time initial download of genomic data, and its ability to construct alignments and phylogenies for whole genome sequencing data from thousands of individuals, as well as other species. With increased usage of next-generation sequencing, access to genome-wide datasets will only increase, and tools such as VCFtoTree will allow anthropologists to better interpret this data. We hope to further improve this tool in collaboration with

the anthropological genetics community and routinely update the instructions for this software to address any concerns raised by the community.

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Variation in relative condyle height in primates

ELIZABETH M. ST CLAIR and JONATHAN MG. PERRY

Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine

Mandibular condyle height (CH) has been functionally linked to both jaw adductor leverage and gape. Some previous studies have found that a low condyle is associated with gouging, while others have not, possibly due to differences in breadth of comparative sample or data treatment. Here, we revisit variation in CH using 1) a very broad comparative sample of extant primates and 2) three alternate methods to calculate relative CH.

CH above tooth row was measured on lateral photographs of 92 species of primates (n=372). Ratio shape variables were created using two size variables as the denominator: 1) geometric mean (GM) of eight caliper skull measurements (ShapeGM), 2) mandible length (ShapeML). Residuals to a regression line of LnCH against LnGM were used as a third method of calculating relative CH (ResGM). Phylogenetic ANOVAs were used to test between dietary groups.

Phylogenetic ANOVAs of ShapeGM and Shape ML were highly significant (ShapeGM: $F=10$, $p<0.00001$, ShapeML: $F=11.4$, $p<0.00001$), with particularly strong differences between gouging primates (gummivores, *Daubentonia*) and other dietary groups. Similar results were obtained using ResGM, but in this analysis the residuals to the ANOVA model departed significantly from a normal distribution, possibly because of the large residual of *Daubentonia*. In conclusion, a broad comparative sample and use of geometric mean vs. mandible length are insufficient to explain differences between previous studies of CH. Our results reinforce previous findings of an association between a low condyle and gouging behavior.

Some of the data analyzed here were collected with support from the American Society of Mammalogists, Geological Society of America, and the Leakey Foundation

Infanticide risk does not appear to explain frequent male-infant interactions in *Colobus angolensis ruwenzorii*

SAMANTHA M. STEAD[1,2] and JULIE A. TEICHROEB[1,3]

[1]Anthropology Department, University of Toronto, [2]School of the Environment, University of Toronto, [3]Anthropology Department, University of Toronto Scarborough

Male care, which includes all behaviours directed toward an infant that are positive and resemble maternal care, is rare or absent in most mammalian species due to the mother's role in gestation and lactation as well as uncertain paternity. If a male is unrelated to an infant, investing effort into infant care can reduce the male's fitness. Therefore, these behaviours should be selected against if paternity is uncertain. Nonetheless, extensive male care has been reported in some primates with high paternity uncertainty, challenging these previous notions. Here, we provide data on adult male infant handling (holding and carrying) for 10 Angolan colobus (*Colobus angolensis ruwenzorii*) infants during 66 focal hours collected from May to August 2017 at Lake Nabugabo, Uganda. Adult males spent more time handling infants than expected for a black-and-white colobus species (e.g. 40 times more than *C. vellerosus*). Since their unique social organization consists of non-territorial core units that frequently fission and fuse, infants are often near unfamiliar males from other core units. We hypothesized that if these strong male-infant interactions function to defend infants from infanticide, only one male (the putative sire) should handle each infant and younger infants, for whom infanticide threat is highest, should be handled more. Analyses showed, however, that multiple males in multi-male core units handled an infant and age was not a significant predictor of handling. More data are needed to understand the function of male care in this species, as our data suggests it is not for protection against infanticide.

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Methodology for quantifying anthropogenic chemical pollutants in primate feces

TESSA STEINICHE[1], MARTA VENIER[2], SHAORUI WANG[2], KEVIN ROMANAK[2], JESSICA M. ROTHMAN[3], RICHARD W. WRANGHAM[4] and MICHAEL WASSERMAN[4]

[1]Department of Anthropology, Indiana University, [2]School of Public and Environmental Affairs, Indiana University, [3]Department of Anthropology, Hunter College, City University of New York, [4]Department of Human Evolutionary Biology, Harvard University

As proximity to human populations intensifies, nonhuman primates are expected to encounter anthropogenic chemical pollutants at increasing rates. Primates may be exposed to persistent synthetic chemicals in the environment and/or through direct ingestion of agricultural pesticides via crop-raiding. Currently, our understanding of primate interactions with pollutants and their subsequent health effects is limited, much of which stems from a lack of quantitative evidence of exposure. Here we present a method for quantifying chemical pollutants and their metabolites in primate fecal samples using a combination of accelerated solvent extraction and solid phase extraction cleanup, and analyzed by gas chromatography-mass spectrometry. We targeted three categories of common contaminants, polybrominated diphenyl ethers (PBDEs), current use pesticides (CUPs), and organophosphorous flame retardants (OPFRs). Methods were validated using 30 fecal samples from captive baboons inhabiting the Peaceable Primate Sanctuary in Winemac, Indiana. Chemical pollutants and metabolites were also examined in 110 fecal samples across four species of wild primates inhabiting Kibale National Park, Uganda, including olive baboons (*Papio anubis*), chimpanzees (*Pan troglodytes*), red colobus (*Procolobus rufomitratus*), and black and white colobus (*Colobus guereza*). Results confirm that our methodology is able to detect presence of these chemicals in feces and quantify variation across a range of individuals, species, and environments. Many chemical pollutants have demonstrated endocrine-disrupting effects, having negative downstream consequences for reproduction and survival. We discuss the implications of physiological and behavioral effects of exposure by means of endocrine-disruption and other potential pathways for primate ecology, conservation, and evolution.

The Value and Possibilities of Geographic Information Systems (GIS) to Address Bioarchaeological Research Questions

MARISSA C. STEWART[1,2], GIUSEPPE VERCELLOTTI[3] and JULIE S. FIELD[3]

[1]Teaching & Learning Transformation Center, University of Maryland, [2]Department of Anthropology, University of Maryland, [3]Department of Anthropology, The Ohio State University

Geographic information systems (GIS) methods are increasingly incorporated into bioarchaeological research. However, the possibilities for its integration are still not widely known. In this presentation, traditional uses of spatial analyses in bioarchaeology (e.g., comparisons based on grids and zones) are compared with possible approaches available through GIS to identify and address research questions. To highlight these possibilities, two medieval Italian cemeteries are used as case studies to demonstrate the utility of using GIS to address bioarchaeological research questions. The skeletal collections from the cemeteries of *Pieve di Pava* (N=125) in Siena, Italy and *Trino Vercellese* (N=77) in Piedmont, Italy both date from the 8th to 13th centuries. Various GIS techniques are discussed including the generation of bioarchaeological site maps, the use of interpolation analyses (inverse distance weighted) to examine the distribution of ratio data (e.g., osteometric and isotopic data), hot spot analyses (using the Gi* statistic) to compare individual skeletal values to those of the entire

sample to identify significantly higher and lower values, and cluster analysis to identify spatial clusters of related skeletal data. The potential value of GIS to bioarchaeological research focuses on the ability to recognize meaningful patterns in the spatial distribution of skeletal data that are not reliant on the survival of archaeological features. Additionally, the ability of GIS analyses to generate new questions and hypotheses, beyond those that can be posed from the skeletal data alone, is demonstrated.

Marital violence and fertility in a relatively egalitarian high fertility population

JONATHAN STIEGLITZ[1], BENJAMIN TRUMBLE[2], HILLARD KAPLAN[3] and MICHAEL GURVEN[4]

[1]Anthropology, Institute for Advanced Study in Toulouse, [2]School of Human Evolution and Social Change, Arizona State University, [3]Economic Science Institute, Chapman University, [4]Anthropology, University of California-Santa Barbara

Given its ubiquity, persistence and potentially adverse consequences for biological fitness, intimate partner violence (IPV) is a conundrum for evolutionary social scientists and policymakers. Two broad, generally distinct causal explanations of physical IPV against women have been proposed: *strategic explanations*, which posit that IPV or its threat is used deliberately by a man to achieve a selfish outcome, and *impulsive explanations*, which posit that IPV is not used deliberately or necessarily in self-interest, but instead is an outcome of stress or men's antisocial personality. Hybrid IPV explanations containing both strategic and impulsive elements have also been proposed, emphasizing a causal role for social learning. Among Tsimane forager-horticulturalists of lowland Bolivia (n=1,905 marital risk-years for 133 marriages of 105 women), we test predictions of strategic evolutionary, impulsive and hybrid (strategic-impulsive) IPV explanations by examining fitness consequences and behavioral and psychological determinants of IPV. We find that IPV predicts greater prospective marital fertility, both across women and across marriages within women, as uniquely predicted by strategic evolutionary but not impulsive or hybrid IPV explanations. IPV rate is positively associated with a husband's attitudes regarding his desire for intersexual control (predicted by a strategic evolutionary explanation), but not by a husband's propensity for intrasexual physical aggression (impulsive explanation), nor by husbands' or wives' childhood exposure to family violence (hybrid explanation). Our results suggest a psychological and behavioral mechanism through which men exert direct influence over marital fertility rate, which may manifest due to sex differences in optimal values of preferred family size.

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Biomechanical signatures of watercraft use in Holocene foragers and modern athletes

JAY T. STOCK[1,2], COLIN N. SHAW[1] and ALISON A. MACINTOSH[1]

[1]PAVE Research Group, Department of Archaeology, University of Cambridge, Cambridge, UK,, [2]Department of Anthropology, Western University, London, ON, Canada

Watercraft are an important component of cultural adaptation to different environments, enabling the colonization of islands and the hunting of sea mammals. As prehistoric watercraft were typically manufactured perishable materials, our knowledge of the extent and intensity of watercraft use in prehistory is minimal. A means of detecting the use of watercraft in the past would improve our understanding of prehistoric behavioural ecology and human dispersals. Intralimb diaphyseal strength indices have been useful in detecting signatures of the use of the upper limbs in locomotion among primates and fossil hominins. This paper compares humeral, femoral, and tibial cross-sectional geometry to determine if watercraft dependent foraging strategies lead to greater humeral strength relative to the lower limbs. We compare Holocene foragers heavily dependent on watercraft use for subsistence and locomotion (Andaman Islanders; Yaghan; Inuit); to those dependent solely on terrestrial locomotion (Iberomaurusian; Later Stone Age South Africans and Tanzanians; Natufians), and modern male and female athletes of known patterns of habitual activity (rowers, soccer players, controls). The results demonstrate that modern rowers have greater humero-femoral and humero-tibial strength ratios, which suggest that there is a signature of the intensity of manual loading during locomotion, in these elements. Prehistoric foragers known to use watercraft habitually also demonstrate higher humero-femoral and humero-tibial ratios than terrestrial foragers, suggesting that watercraft use in the past can be detected by the relative intensity of manual loading. The results provide a means of inferring past watercraft use in absence of archaeological evidence.

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The Ontogeny of Craniofacial Sexual Dimorphism in Extant African Apes

MICHALA K. STOCK

Anthropology, University of Florida

Sexual dimorphism constitutes an integral aspect of primate skeletal biology and is a main contributor to intraspecific variation in our clade. This study sought to characterize the timing and patterns of developing cranial sexual dimorphism among extant apes, to better inform the study of fossil hominids. Thirty-five standard craniometric points were digitized from crania of male and female juvenile *Pan troglodytes* sspp.(n=149) and *Gorilla* spp. (n=63) museum specimens.Age was assessed based on dental development, ranging from the onset of M^1 through M^3 eruption. Three-dimensional landmark data were subjected to relative warps analysis in size-shape space from which allometric trajectories and shape changes were compared between taxa. The cranial ontogenetic trajectories of gorillas and chimpanzees are parallel but non-overlapping, indicating divergence prior to the youngest specimen's age. Furthermore, although the taxa overlap in morphospace, the location of sex-based shape differences are distinct between them prior to M^2 eruption: chimpanzees vary most in the basicranium, whereas gorillas vary most in the lateral vault. After M^2 eruption, sex-based morphological differences are more similarly-patterned between these taxa. A factorial MANOVA comparing the effects of sex, age, taxon, and their interactions on cranial shape found that all main effects and their interactions were significant (p<0.001). These results suggest that while ontogenetic scaling contributes to developing sexual dimorphism in these taxa, processes outside of pure heterochrony contribute to the distinctive, sex-based differences seen among extant great apes, supporting their further investigation to enhance discernment of within- versus among-species variation in the fossil record.

The New Mexico Bioarchaeology Database Project

ANN L.W. STODDER[1,2] and SHAMSI D. BERRY[3]

[1]Office of Archaeological Studies, Museum of New Mexico, [2]Department of Anthropology, University of New Mexico, [3]Department of Health Informatics and Information Management, University of Mississippi Medical Center

Nearly 200,000 archaeological sites are recorded in New Mexico, and the study of human remains here has a 150 year history. This project entails compiling the widely dispersed bioarchaeological data, starting with Museum of New Mexico projects that include the earliest CRM archaeology in the region: pipelines, dams, highways. Initial reanalysis of assemblages from 1950s-60s projects reveals a broad distribution of pre-contact tuberculosis in the San Juan Basin and a high frequency of scurvy in children at Chacoan

outliers, among other new findings. The Access database accommodates legacy data from archives, but it was designed for the work flow of bioarchaeological analysis in our current projects. Site data include cultural and temporal systematics, component types, excavation history, and bibliographic citations. Data protocols are consistent with *Standards*. The paleopathology database uses observational categories from *Osteoware* and calls for documentation of lesion observability in each element, which facilitates explicit prevalence data. Challenges inherent in this large-scale effort include concordance across data sets, the daunting scope of archival work, and the widely held (inaccurate) belief that MNI estimates generated for NAGPRA reports constitute full analysis. The variation between archival data sets reflects the changing foci of skeletal analysis over the last decades, but does not negate the value of gathering the information into a knowledge base. The accelerating pace of repatriation and denied access to museum collections lend urgency to this project, as does the emphasis on data mining and data sharing that guide Southwest archaeology today.

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New Ancient DNA from Palau Shed Light on Early Micronesian Settlement

JESSICA H. STONE[1], CAROLINE KISIELINSKI[2], JUSTIN TACKNEY[2], SCOTT M. FITZPATRICK[1], NELSON TING[1] and DENNIS O'ROURKE[2]

[1]Department of Anthropology, University of Oregon, [2]Department of Anthropology, University of Kansas

The prehistoric settlement of Remote Oceania represents one of the most widespread and rapid dispersals in human history. While a transdisciplinary approach utilizing linguistic, archaeological, and biological evidence has been successful in establishing basic chronologies and general trajectories for much of the region, the coarseness of the data available for Micronesia, located in the northwest tropical Pacific, has prevented researchers from identifying points of origin for the earliest settlers. The Chelechol ra Orrak rockshelter located in Palau, western Micronesia, however, has great potential to provide a wide range of osteological and genetic information regarding some of Micronesia's earliest inhabitants as it contains one of the largest and oldest human skeletal assemblages in the Pacific Islands (ca. 3000 -1700 BP). Here, we present the results of research involving recovery of ancient DNA (aDNA) from eight individuals that were buried at Chelechol ra Orrak. We performed both targeted sequencing of the mitochondrial control region as well as hybridization capture of full mitogenomes on a subset of the samples. Determined haplotypes are compared to previously published ancient and modern data from East and Southeast Asian and Oceanic populations, and preliminary results from the mitochondrial control region suggest an affinity with both modern individuals located in Island Southeast Asia and modern Palauans. Analysis of full mitogenomes will provide more refined population affinities in order to hypothesize the most likely origins for the individuals buried at Chelehol ra Orrak.

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Shaping the proper female: Beauty, bodies, and the bioarchaeology of structural violence in the Victorian Era

PAMELA K. STONE

CSI, Hampshire College

Examination of direct forms of control in the bioarchaeological record have been limited to physical violence identified as traumatic bodily injury, seen on the skeleton as healed defensive fracturing, cut marks, blunt force trauma, and in some cases burial position. But there are indirect modes of control that present as skeletal deformation which occur over long periods of time, that are not often included in the suite of bioarchaeological indicators of violence. This "chronic violence" manifests as physiological and psychological control, and when read properly can reveal structural inequalities often disguised as expected social performance as dictated by the elite or ruling class, or as social control over those on the margins. Until recently these markers of control over females have lacked a strong critique. This poster critiques the legacy of subornation of females in the Victorian era as directly tied to race science and Victorian social expectations of the civilized, white, yet weak, female, and how this continues to inform interpretations of females in both the past and present. Engaging new ways of reading chronic violence by combining skeletal markers of deformation, ethnology, and historic contexts may reveal the impact of structural violence on the individual. Focus here on the use of corsets to "bind females" and shape bodies in the performance of Victorian era beauty standards, revealing how the complexity of indirect cultural violence that asserts control over female bodies, forged in the industrial era, influences narratives about females in the bioarchaeological record and in biomedicine today.

Age-at-death estimation based on the female pubic symphysis using computational methods and 3D laser scans

DETELINA K. STOYANOVA[1,2], JIEUN KIM[1], CRISTINA FIGUEROA-SOTO[3], DENNIS E. SLICE[1,4] and BRIDGET FB. ALGEE-HEWITT[1,5]

[1]Scientific Computing, Florida State University, [2]Department of Mathematics and Statistics, University of North Carolina at Charlotte, [3]Waukesha County Medical Examiner's Office, [4]Department of Anthropology, University of Vienna, [5]Department of Biology, Stanford University

The most popular and widely used skeletal indicator for age-at-death estimation is the pubic symphysis. Recently, novel computational, shape-based, aging methods have been proposed as alternatives to traditional visual-scoring methods to address recognized limitations, especially high inter-/intra-observer error. However, these new methods were developed on 3D laser scans of males, and their applicability to female skeletal remains has not been substantiated. In this study, we show that these computational techniques can successfully be applied to females despite extrinsic factors (e.g., childbirth and osteoporosis) that may alter the morphology of the pubic symphysis and make accurate age-at-death assessment of females challenging. This study uses 3D laser scans from 55 documented female skeletons whose ages range from 15 to 99 years. The results are based on two surface scores and one outline measure that are shown to be associated with age in males. As our sample is skewed towards older individuals, we generate different data subsamples, preserving the ratio between individuals who are younger and older than 40 years. The results of regression models produced for the different subsamples show that the shape measures are associated with recorded age-at-death. R-squared values indicate that 30% to 55% of the shape variation is explained by age and p-values are significant (alpha=0.05). An additional individual asymmetry analysis based on 34 females shows that both sides can be used interchangeably for age-at-death estimation using these new methods. Furthermore, testing finds that individual asymmetry is not significantly associated with advanced age, number of children, weight or stature.

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The systematics of robust australopiths

DAVID S. STRAIT[1], CARRIE S. MONGLE[2] and FREDERICK E. GRINE[3]

[1]Anthropology, Washington University in St. Louis, [2]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, [3]Anthropology and Anatomical Sciences, Stony Brook University

Fossils of robust australopiths are typically assigned to one of three species that are, in turn, conventionally assigned to *Australopithecus* or *Paranthropus.* Although one might question the three-species model on theoretical grounds, current evidence suggests that this model is a viable working hypothesis. In contrast, the genus level taxonomy is intimately tied to the

phylogenetic relationships among the three species, and the complexities associated with discerning those relationships remain essentially the same as those articulated by Kimbel, White and Johanson in the last symposium dedicated to understanding the robust australopiths. Namely, any cladogram or phyletic tree that includes both *A. africanus* and *P. aethiopicus* will exhibit homoplasy. However, since the discovery of the Black Skull, a key methodological innovation has been the introduction of computer-assisted cladistic analysis into paleoanthropology. Here we present an updated cladistic analysis of early hominins that demonstrates, as have other studies, that the robust australopiths are monophyletic and the best supported clade among any early hominin group (Bayesian posterior probability = 1; parsimony bootstrap support = 96%). Given the well-supported monophyly of these species, all three should be assigned to a single genus, *Paranthropus*. However, specific evolutionary relationships within the genus *Paranthropus* remain somewhat unresolved. Thus, more work is required to resolve the relationships within this clade. Importantly, *Paranthropus* monophyly has significant implications for patterns of early hominin biogeography and character evolution.

This research was supported by a grant by the Wenner-Gren Foundation for Anthropological Research (Gr. 9120).

What climate change means for primates and primatology

KAREN B. STRIER

Anthropology, University of Wisconsin-Madison

There is ample evidence that global climate changes will profoundly impact primates at local and regional scales. These impacts include both direct and indirect effects, with corresponding consequences for individual fitness, population viabilities, and the biogeographical distribution of species. Many of these impacts will be mediated through the effects of changing temperature and rainfall patterns on primate habitats, and specifically, on the spatial and temporal abundance and distribution of essential resources such as food and water. Climate change is also predicted to lead to physiological stressors and health-related problems from greater thermoregulatory demands, energetic imbalances, and increases in the severity and distribution of zoonotic diseases. Primates with small populations and restricted distributions are expected to be most severely affected, although populations that have already been pushed into marginal habitats may be better equipped to cope than those found at the center of their species' range. The rapidity with which climate change is occurring poses new challenges for primatologists as well. These challenges include the difficulties of evaluating assumptions about whether behavior patterns selected under different ecological and demographic conditions are adaptive today, and of distinguishing between behavioral variation and behavioral flexibility, which may lead to local traditions that become fixed in populations or that remain fluid and subject to change. Primatologists will also have to confront what the inevitability of local population extinctions will mean in terms of lost biodiversity and our perspectives on intraspecific variation.

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A Modified Human Cranium: "Cultural Heritage Object" or "Work of Art"?

PHOEBE R. STUBBLEFIELD

Anthropology, University of North Dakota

The purpose of this presentation is to disseminate an analysis of stylistic features drawn from literature of traditionally modified skulls from certain Southeast Asian tribal groups, for the purpose of screening a cranium that was seized in a recent commercial transaction. A limited craniometric analysis was a component of this screening, although this presentation emphasizes stylistic features due to the legal question of interest.

A cranium seized by the United States Immigrations and Customs Enforcement was submitted for a brief examination with the concern that it represented an antiquity. Although Tibetan kapala skulls were the focus of the inquiry, this cranium most resembled the Asmat and similar Papua New Guinean (PNG) tribal traditions for ancestor skulls due to the presence of engravings and embedded shells. However, this specimen diverged in a manner indicative of a focus on the modern collectibles trade. Although the cranium did not qualify stylistically as an antiquity, it could not be excluded from having archaeological interest based on the non-destructive tests applied here.

Trade in human remains as collectibles can present a variety of legal challenges in the United States, especially when the trade is international. U.S. participation in UNESCO (United Nations Educational, Scientific and Cultural Organization) creates certain standards for importation or trade of items that in any part qualify as having archaeological or ethnological interest (19 United States Code 2600).

No external funding was received in the pursuit of this analysis.

Paleoenvironment of the Lower Laetolil Beds (3.85 Ma to >4.36 Ma) at Laetoli, Tanzania

DENISE F. SU[1,2], TERRY HARRISON[2] and AMANDUS KWEKASON[3]

[1]Paleobotany and Paleoecology, Cleveland Museum of Natural History, [2]Anthropology, Center for the Study of Human Origins, New York University, [3]Museum and House of Culture, National Museum of Tanzania

Laetoli (Tanzania) is best known for the occurrence of *Australopithecus afarensis* and trails of hominin footprints from the Upper Laetolil Beds (~3.6 Ma to 3.85 Ma). The associated fauna and flora are well documented and include a diversity of fossil vertebrates, invertebrates, plants, and ichnotaxa. In contrast, the fauna of the older Lower Laetolil Beds (3.85 Ma to >4.36 Ma) has not been systematically studied and there has not been a comprehensive account of its paleontology, geology and paleoecology. This results in a gap in our knowledge of the regional faunal diversity and paleoenvironmental conditions at Laetoli before the appearance of *A. afarensis*. To address these issues, we have conducted more intensive fossil collections in the Lower Laetolil Beds (LLB), which resulted in a significantly enlarged sample of fossils that allows us to have a much better appreciation of the regional faunal community and paleoenvironment during the early Pliocene at Laetoli. We examined the LLB community structure using dietary and locomotor variables and compared it with those of the Upper Laetolil Beds (ULB), Upper Ndolanya Beds (UNB), modern African protected areas, and contemporary sites in eastern Africa to better understand its paleoecological context. The LLB paleoenvironment appears to have been more mesic than those of the ULB or UNB. We also compared faunal similarity among the Laetoli faunas and those of contemporary eastern African sites to explore zoogeographic relationships. Our results show that there was significant faunal continuity within the Laetoli stratigraphic sequence and a high degree of regional endemism.

Fieldwork at Laetoli was supported by Grants from National Geographic Society, the Leakey Foundation, and the National Science Foundation (Grants BCS-0216683, BCS-9903434, BCS-0309513, BCS-1350023)

Mechanisms of fatal toxoplasmosis in primates

YARAVI SUAREZ[1], KATHRINE VAN ETTEN[1], SUVANTHEE GUNASEKERA[1], NEGIN VALIZADEGAN[1], WILLIAM WITOLA[2], JORG LINDE[3] and J. F. BRINKWORTH[1]

[1]Anthropology, University of Illinois Urbana-Champaign, [2]Pathobiology, College of Veterinary Medicine, University of Illinois Urbana-Champaign, [3]Systems Biology and Bioinformatics, Leibniz Institute for Natural Product Research and Infection Biology, Hans Knoll Institute

Toxoplasma gondii is a feline-borne obligate intracellular parasite known to manifest as severe, systemic infections in immunocompromised/pregnant humans and warm-blooded vertebrates that lack evolutionary history with cats. In most healthy, adult mammals *T. gondii* manifests as an asymptomatic, lifelong infection. In primate species with limited evolutionary

exposure to felines, such as New World monkeys and Malagasy lemurs, the parasite tends to generate swift and fatal necrotizing infections, with the mortality rate of some species nearing 100%. Environmentally pervasive and spread by unhygienic human cat care habits, *T. gondii* infection is a OneHealth issue that presents a challenge for both human health and primate care. In mouse strains susceptible to severe infection, monocytes fail to limit the parasite. To assess why some primates suffer severe infections, while others control *T. gondii,* we infected monocytes from healthy animals that develop lifelong (humans, rhesus macaques) and severe (common marmosets, ring-tailed lemurs) infections, with *Toxoplasma gondii* RH for 12 and 24 hours. We assessed cell parasite load, cell death via fluorescent microscopy and whole genome expression through RNA-seq. Monocytes from the "severe" group maintain higher parasite loads, and undergo apoptosis at a higher rate. Interspecies differences in gene expression across multiple gene families, including host genes involved in inflammation, were noted. Parasite gene expression also strongly differed between susceptible and resistant infection groups. These findings suggest that primate monocyte function has diverged in a pattern fitting evolutionary exposure to *Toxoplasma* and may explain inter-species differences in toxoplasmosis mortality.

A comparison of worldwide phonemic and genetic variation in populations in Asia

ALEXANDRA SUROWIEC[1], SOHINI RAMACHANDRAN[3,4,5], MARCUS W. FELDMAN[2] and NICOLE CREANZA[1]

[1]Department of Biological Sciences, Vanderbilt University, [2]Department Biology, Stanford University, [3]Department of Ecology and Evolutionary Biology, Brown University, [4]Department of Computer Science, Brown University, [5]Center for Computational Molecular Biology, Brown University

Worldwide patterns of genetic variation are driven by human history. To test whether this demographic history has left similar signatures on phonemes to those it has left on genes, we analyzed phonemes from 2,082 languages and microsatellite polymorphisms from 246 populations. Globally, both genetic distance and phonemic distance between populations were significantly correlated with geographic distance; populations that were closer to one another tended to be more similar, genetically and linguistically. Close examination of this pattern suggests the influence of two processes: vertical transmission of both genes and languages during the peopling of the world, and linguistic borrowing (often coupled with genetic admixture) when neighboring populations speak very different languages. In Asia, multiple language families have coexisted for millennia, and there are several locations in Asia with phonemes found nowhere else, so understanding the interactions between these vertical and horizontal processes is particularly important. Here, we synthesize mitochondrial and autosomal genetic data with multiple sources of cultural information, including language features and ethnographic data from D-PLACE, to enhance our understanding of human demographic history of Asia.

This work was funded in part by the Ruth Landes Memorial Research Fund and the Stanford Center for Computational, Evolutionary, and Human Genomics.

The use of calls to distinguish previously unrecognised primate species

MAGDALENA S. SVENSSON and SIMON K. BEARDER

Department of Social Sciences, Oxford Brookes University

Animals are attracted to mating partners by a variety of signals depending on the development of their sensory modalities. Most species use a combination of senses to ensure that they mate with an appropriate partner and, consequently, differences in their signalling systems vary in a species-specific way. For example, species that combine visual, olfactory and auditory signals will look, smell and sound different from their close relatives and we recognise distinct species by these diagnostic features. Among nocturnal primates, visual differences can be difficult to distinguish at night and differences in smell are highly cryptic, but their patterns of calling and the structure of calls have proved to be reliable discriminators. Here we quantify differences in the calling patterns of three species and six subspecies of galagos, including the newly discovered Galagoides kumbirensis. On the basis of 147 calls we show that there is clear divergence between calls used to attract companions at a distance within and between species. Furthermore there are clear species typical differences in the number and patterning of other calls in the vocal repertoire. These can vary between six and twenty-five structurally distinct sounds. We argue for a more comprehensive integration of quantifiable vocal characteristics into primate species taxonomy and assessment of within species variation.

The effect of the angiotensin-converting enzyme (ACE) I/D polymorphism on energy expenditure in modern humans

ZANE S. SWANSON[1,2], HERMAN PONTZER[2,3], AMY LUKE[4], LARA R. DUGAS[4] and MICHAEL E. STEIPER[2,3]

[1]Department of Anthropology, The Graduate Center, CUNY, [2]New York Consortium in Evolutionary Primatology, NYCEP, [3]Department of Anthropology, Hunter College, CUNY, [4]Public Health Sciences, Stritch School of Medicine, Loyola University Chicago

The insertion/deletion (I/D) polymorphism of *ACE*, the gene that codes for angiotensin-converting enzyme, has long been the focus of studies concerning the genetic basis for athletic performance. Previous studies have examined the effects of the *ACE* genotypes on physical endurance, but have largely neglected the potential energetic implications of this polymorphism. Here we test whether *ACE* genotypes are associated with total energy expenditure (TEE), measured using doubly labeled water, in a large sample of adult humans (n=211) from five populations. Using multivariate analysis that adjusted for body size and composition, we found a relationship between the *ACE* genotypes and both TEE and activity energy expenditure (AEE), calculated as the difference between TEE and the combined expenditure of basal metabolic rate and digestive cost. The insertion allele homozygotes (I/I) exhibited significantly lower TEE (-142 kcal/day) compared to deletion homozygotes (D/D), while these same insertion homozygotes also exhibited significantly lower AEE (-229 kcal/day) compared to deletion homozygotes. Heterozygotes (I/D) were found to exhibit intermediate values of TEE and AEE. These results suggest that variations in the *ACE* gene influences energy expenditure in humans.

Funding for this study was provided by the NYCEP IGERT grant.

Evaluation for the Use of Transverse Palatine, Zygomaticomaxillary, and Metopic Sutures in Ancestry Estimations

MARY C. SWEARINGER and ROBYN T. KRAMER

Anthropology, Texas State University

The purpose of this study is to observe if traits that have been used for ancestry estimations have a biological basis or if environmental stressors are contributing to their presence and expression in populations. If the shape of the zygomaticomaxillary and transverse palatine suture and presence of a residual metopic suture are found to be inconsistent with a biological factor, they should not be utilized in ancestry estimation in biological anthropology. The sample includes two skeletal collections housed at Texas State University, specifically the donated skeletal collection and the collection of unidentified Latin American migrants. The collections contain individuals who are associated with existing ancestry categories of "American Black", "American White", and "Hispanic". We hypothesize that if the sample does not exhibit traits that have been traditionally associated with these ancestry groups, then there may not be a biological basis for the expression of the trait. The expression may be reliant on external factors such as the environment or nutrition. Methods include observing asymmetry and expression in these three sutures. A standardized scoring method has been established for each suture to allow for statistical analysis. Results show that the American Black sample exhibit high levels of symmetry for all sutures,

while the Hispanic and American White samples show similar patterns of equal probabilities for exhibiting asymmetrical and symmetrical zygomaticomaxillary and transverse palatine sutures. These results show that the American Black sample may not be experiencing the same environmental stressors as the Hispanic and American White individuals in the sample.

Decapitation: A Case Study and Review of the Literature

VICTORIA M. SWENSON[1], REBECCA L. GEORGE[1], MARIN A. PILLOUD[1] and LAURA D. KNIGHT[2]

[1]Anthropology, University of Nevada, Reno, [2]Pathology, Washoe County Regional Medical Examiner's Office

Intentional and accidental separation of the head is well documented in the medicolegal and bioarchaeological literature. Such practices have been documented from the Neolithic to the Middle Ages, and beyond. In a medicolegal context, it is not uncommon for a forensic anthropologist to encounter remains where the head has been removed. A review of the literature identified 121 cases of decapitation in a medicolegal context (both accidental and intentional). Of these cases, 52 clearly stated the anatomical location of the decapitation; only these cases are discussed here. The majority of cases (n=35, 67.3%) occurred at the mid-neck, in the region of the second to fifth cervical vertebra. This finding is likely due to 1) the anatomy in this area, which makes it a weaker area, and 2) the relative exposure of the mid-neck. Additionally, muscle attachments at the base of the cranium and additional ligaments encountered between the cranial base, atlas, and axis may make separation more difficult in the superior portion of the neck. In the lower neck region, the rhomboids and the transverse portion of the trapezius may also hinder separation. Decapitations in these regions may require additional force for complete separation. A case study is also presented that illustrates lower neck decapitation with additional blunt force trauma. In bioarchaeological and forensic anthropological analyses, it is helpful to have a working knowledge of common locations of decapitation and the soft tissue involved during interpretation and documentation of such trauma.

Patellar maltracking and the hominin distal femur

ADAM D. SYLVESTER[1], ANDREW J. COSGAREA[2] and MIHO J. TANAKA[2]

[1]Center for Functional Anatomy and Evolution, The Johns Hopkins University School of Medicine, [2]Department of Orthopaedic Surgery, The Johns Hopkins University

Several features of the distal femur distinguish australopiths from later hominins, including modern humans. Important among these is the anterior projection of the lateral lip of the patellar surface, argued to be critical for a valgus knee to prevent patellar subluxation or dislocation. Here, we compare the shape of hominin distal femoral fossils to a reference sample that includes modern humans with a clinical history of symptomatic patellar instability.

Surface models of distal femora of *Pan troglodytes* (n = 35), *Gorilla gorilla* (n = 24), *Homo sapiens* (n = 58), and three fossil hominins (A.L. 129-1a, A.L. 333-3, TM 1513) were created from computed tomography scans (live patients) or surface scans (dry bones and fossil casts). Twenty-three of the human femora were from individuals with a clinical history of patellar instability. Sliding semilandmarks were distributed across each articular surface using standard geometric morphometric procedures. All specimen were aligned using Generalized Procrustes Analysis and shape variation was summarized using principal components analysis.

Randomization tests indicate that the distal femora of patients with patellar instability are shaped differently than the rest of the human sample ($p<0.001$), with differences concentrated in the patellar surface. The australopithecine fossils are intermediate between apes and modern humans. When landmarks representing the patellar surface are analyzed separately, the clinical sample and the fossils converge on the ape morphology, both having flatter patellar surfaces compared to the rest of the human sample. These results suggest australopiths may have had a patellar tracking mechanism similar to the clinical sample.

Intra-demic morphological variation: using the Cayo Santiago macaques to model plasticity in the fossil record

HANNAH TABOADA[1], SUSAN C. ANTÓN[1], SCOTT A. WILLIAMS[1], MYRA F. LAIRD[2], MICHAELA K. STOCK[3], CATALINA I. VILLAMIL[1,4], SAMUEL E. BAUMAN SURRAT[5], OLGA GONZALEZ-VELEZ[5], CHRISTOPHER A. SCHMITT[6], CONSTANCE DUBUC[1] and JAMES P. HIGHAM[1]

[1]Anthropology & CSHO, New York University, [2]Organismal Biology & Anatomy, University of Chicago, [3]Anthropology, University of Florida, [4]Anthropology, Dickinson College, [5]Pathology, Caribbean Primate Research Center, [6]Anthropology, Boston University

Developmental plasticity, or the ability to modify development in response to environmental conditions, results in differences in size, shape, and dimorphism across human populations. These differences predict overall smaller adult sizes, and lower levels of dimorphism in instances of resource scarcity and high predator load – predictions that have been used to explain regional variation in *H. erectus*. However, determining whether human variability is similar to other widely dispersed nonhuman primates and can be retrieved from the skeletal record requires data rarely available for extant skeletal collections. The Cayo Santiago macaques provide an opportunity to ground-truth skeletal and somatic measures and to consider demic variation. Our data across 35 primate 'populations' suggest skeletal and somatic mean values track one another, but measures from the same individuals are often lacking even in the Cayo sample. Here we compare somatic and skeletal measures from the same individuals of a single recent cohort (group HH; n=106) from Cayo Santiago. We collected 80 somatic measures (including 47 proxies of bone measures) and, post-maceration, skeletal dimensions for these individuals. We compare skeletal and somatic measures within individuals and skeletal measures with our broader dataset. Skeletal measures yield the best predictions of the somatic bone-proxies in adults, raising the possibility for developing 'correction factors' that allow comparison of somatic and skeletal databases. The two variable types (matched by measurement) also yield similar patterns of variation (CV), and sexual dimorphism suggesting fossil variation may be interpreted using matched somatic measures.

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Homeotic transformation of vertebrae at the thoracic-lumbar border in humans: Association with number of sacral vertebrae and obstetrical significance

ROBERT G. TAGUE

Geography and Anthropology, Louisiana State University

Understanding determinants for number of sacral vertebrae is important because sacral length influences pelvic size and obstetrical success. Previous research demonstrates associations between homeotic transformation at the lumbar-sacral and sacral-coccygeal borders with number of sacral vertebrae and pelvic size. This study considers whether homeotic transformation at the more distant thoracic-lumbar border also influences number of sacral vertebrae. Study sample is 650 skeletonized individuals (149 females and 501 males) between ages 20 to 39 with 24 presacral vertebrae (modal number). Chi-square and Fisher's exact tests are used in analyses. Results show that the sexes are nonsignificantly different from one another in frequencies for numbers of sacral, thoracic, and prediaphragmatic vertebrae. Therefore, the sexes are combined in other analyses. Frequencies for number of sacral vertebrae (S) among individuals with modal numbers of prediaphragmatic vertebrae (19) and of each presacral regional segment (7 cervical [C], 12 thoracic [T], and 5 lumbar [L]) are 1% (S=4), 66% (S=5), 32% (S=6), and 2% (S=7+). Among individuals with modal

numbers of C,T,L vertebrae, numbers of prediaphragmatic and sacral vertebrae are significantly associated. Among individuals with the modal number of prediaphragmatic vertebrae, numbers of thoracic and sacral vertebrae are significantly associated. Results suggest these interpretations: (1) among individuals with modal numbers of C,T,L and prediaphragmatic vertebrae, there is high propensity for homeotic transformation at the sacral-coccygeal border (i.e., high frequency of S=6), and (2) homeotic transformation at the thoracic-lumbar border alters this propensity for transformation at the sacral-coccygeal border and, thereby, is obstetrically important.

New sivapithecine fossil from the early Late Miocene in central Myanmar

MASANARU TAKAI[1], THAUNG HTIKE[2], ZIN MAUNG MAUNG THEIN[3] and REIKO T. KONO[4]

[1]Primate Research Institute, Kyoto University, [2]Department of Geology, Meiktila University, [3]Department of Geology, Magway University, [4]Faculty of Letters, Keio University

A new sivapithecine fossil was discovered from the early Late Miocene site near Magway, central Myanmar in February 2017. The specimen consists of a right partial maxilla, premaxilla and palate, preserving P^4-M^3 and alveoli of I^1-P^3. Judging from the size of upper canine alveolus, it is presumed to be an adult male individual. No enamel crenulation was observed on the surface of molars, though they are somewhat weathered. The new specimen clearly differs from an isolated upper molar of *Khoratpithecus* sp., which has been discovered from this area (Jaeger et al., 2011), in having no enamel crenulation.

Overall morphology of the specimen is similar to that of *Sivapithecus* of the Siwaliks in India/Pakistan. In dental size it is much larger than S. simonsi, the smallest species of *Sivapithecus*, and smaller than *S. parvada*, the largest species, and corresponds to *S. indicus* and *S. sivalensis*. The combination of animal fossils collected from the same site, including *Hipparion* (Equiidae), *Bramatherium* (Giraffidae), *Hippopotamodon* (Suidae) and *Anisodon* (Chalicotheriidae), suggests an age of 10-8 Ma, which corresponds to the date of *S. sivalensis* (Kelley, 2002). However, the new specimen has a more "parabolic" dental arcade with relatively small premaxilla, differing from a "parallel" dental arcade with large, protruding premaxilla in *Sivapithecus* specimens in Siwaliks. The new sivapithecine fossil of central Myanmar may not resemble Sivapithecus in the morphology of snout.

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Shellfish exploitation, resource depletion, and technological change, in a monkey model system

AMANDA TAN[1], LYDIA V. LUNCZ[2], MICHAEL HASLAM[3], LARS KULIK[4], TOMOS PROFFITT[3], SUCHINDA MALAIVIJITNOND[5] and MICHAEL D. GUMERT[3,5,6]

[1]Department of Anthropology, Dartmouth College, [2]Institute for Cognitive and Evolutionary Anthropology and Museum Ethnography, University of Oxford, [3]Primate Archaeology Research Group, School of Archaeology, University of Oxford, [4]Department of Primatology, Max Planck Institute for Evolutionary Anthropology, [5]Department of Biology, Faculty of Science, Chulalongkorn University, [6]Division of Psychology, School of Humanities and Social Sciences, Nanyang Technological University

The tempo and magnitude of shellfish size reduction in Holocene South Africa has been interpreted as evidence of intense human exploitation, leading to hypotheses that coastal resources were crucial to the origins and dispersal of modern humans. This argument stems largely from the marginal value theorem, which predicts harvesting the largest shellfish first, as these would provide the most profitable foraging returns. Furthermore, the demands of maintaining foraging productivity in response to diminishing resource availability are thought to facilitate technological innovation in hunter-gatherer economies. Testing these hypotheses however, has been difficult without appropriate model systems. Recently, we found that in Khao Sam Roi Yot National Park, Thailand, two adjacent islands are home to different-sized long-tailed macaque populations (*Macaca fascicularis*) that habitually exploit shellfish using stone tools. The predator-prey interaction between macaques and shellfish on neighboring islands provides a model system for examining hypothesized links between shellfish exploitation on prey biology, and the associated implications for interpreting the archaeological shellfish record. We compared the availability, sizes, and maturation stages of shellfish on the two islands. Our results demonstrate that shellfish size and abundance is significantly reduced where the macaque population size is larger. In addition, the reduction in the size of available shellfish was commensurate with a reduction in tool sizes used by the monkeys to exploit these smaller prey items. These findings support the utility of interpreting archaeological shellfish size reductions as indicators of hominin exploitation, and provide evidence that resource depletion can facilitate technological change in hunter-gatherer communities.

Subtle sexual dichromatism and dimorphism detected in wild *Propithecus diadema*

ELIZABETH TAPANES[1], MITCHELL T. IRWIN[2], AMANDA N. SPRIGGS[1,3], JASON M. KAMILAR[4] and BRENDA J. BRADLEY[1]

[1]Center for the Advanced Study of Human Paleobiology, The George Washington University, [2]Department of Anthropology, Northern Illinois University, [3]Department of Anthropology, University at Albany – SUNY, [4]Department of Anthropology, University of Massachusetts – Amherst

Sexual dichromatism and dimorphism are intriguing aspects of primate phenotypic diversity that are likely shaped by sexual selection. Although primate size and canine dimorphism have been widely studied, many primates exhibit subtle sexual dichromatism and dimorphism (e.g. in skin and pelage) that remains relatively unexplored. Such diversity is of interest given that dichromatism in other taxa (e.g. plumage in birds), suggests that sexually selected traits may drive speciation and/or function as honest quality signals. To address this issue in primates, we analyzed pelage color and morphology (e.g. density, width) for 15 wild *Propithecus diadema* lemurs from Tsinjoarivo, Madagascar, where a variety of pelage phenotypes have been documented. While animals were sedated for routine captures, we obtained color-calibrated photos and microscopic photos of hair at 100x magnification. Males and females differed in aspects of coloration (e.g. females' mid-belly is darker; $p = 0.025$), and 'hairiness' (e.g. females' crown/scalp hair is less dense, $p = 0.038$). Although most lemurs are thought to be sexually monomorphic, these results represent the first evidence of sexual dichromatism and dimorphism within a *Propithecus* population. Such subtle aspects of sex-based phenotypic differences can reveal novel findings about selection, behavior, and biology. We are now exploring this across Indriidae. Further investigation into the evolution of pelage, including underlying genomic mechanisms, is warranted to understand how selection is acting on various axes of pelage variation at macro- and micro-evolutionary scales.

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An Evaluation of the Howells' Dataset for Determining Ancestry in Known Pacific Northwest Native American Crania: Implications for Kennewick Man

GUY L. TASA and JULIETTE VOGEL

Department of Archaeology and Historic Preservation, Washington State Historic Preservation Office

From 1973 to 1989, anthropologist W.W. Howells collected cranial measurement data on 28 recent

world-wide human populations including four Native American populations. His data is openly available and has been used extensively by researchers in an attempt to estimate the ancestral relationships and origins of populations and individuals from both forensic and bioarchaeological contexts. Cranial measurements collected on 228 precontact Native American crania from the Pacific Northwest were compared to Howells' 28 groups utilizing discriminant function analysis statistics available in FORDISC 3.1 to determine ancestry. We hypothesize that the known Native American crania would be identified as one of the four Native American populations in the Howells' dataset.

For the 228 individuals examined, a total of 1,605 comparisons were made with FORDISC 3.1 in a methodologically rigorous effort to determine ancestry. Eight different combinations of comparison populations and measurement variables were tested. At a minimum typicality of 0.05, 40% of the comparisons did not yield a classification. Of comparisons that did yield a classification, only 49% indicated Native American ancestry.

We argue that, for precontact Native Americans of the Pacific Northwest, the Howells' dataset by itself is inappropriate for determining ancestry. Containing only four Native American groups, his data do not capture the incredible variability among all Native American crania including Native peoples of the Pacific Northwest. Implications for studies attributing Kennewick Man's affiliation on the basis of the Howell's dataset are discussed.

Sharing of deletion polymorphisms reveal additional pulses of Neanderthal introgression

RECEP O. TASKENT, JUSTIN BRADLEY, YEN-LUNG LIN and OMER GOKCUMEN

Biological Sciences, SUNY at Buffalo

Neanderthals contributed genetic material to modern humans. Isolated and largely distinct Neanderthal populations may have interacted with humans. However, it is not clear whether only one or more of these distinct populations contributed genetic material to modern humans. Sharing of large deletion polymorphisms between humans and Neanderthal genomes provides a unique opportunity to address this question. Because, these large deletion polymorphisms are unlikely to be recurrent if they share exact breakpoints and thus identical-by-descent. Consequently, we can argue that allele sharing between Neanderthals is either due to incomplete lineage sorting or introgression. With the recent availability of a second high-quality Neanderthal genome from Croatia along with the well-studied Neanderthal genome from Altai, we were able to compile the polymorphic deletion polymorphisms in present-day humans that are also variable among the two Neanderthals. Using population genetics analyses, we identified 238 deletion polymorphisms that are polymorphic in humans and present in either one of the Neanderthal genomes. To confirm this trend, we have detected 443 distinct haplotypes across the human genome that are likely introgressed from just one of the two Neanderthal lineages and not the other. Our results confirmed the previous observation that Croatian Neanderthal lineage was the primary source of introgressed sequences observed in modern human genomes, but raised the possibility of an additional, low-level introgression from Altai Neanderthal in human genomes.

Can we extend Kay's observation on the distinctiveness of bilophodonty among primates to include cercopithecine skull form, jaw-muscle fiber architecture and microwear?

ANDREA B. TAYLOR[1], MARK F. TEAFORD[1] and CHRISTOPHER J. VINYARD[2]

[1]Department of Basic Sciences, Touro University, [2]Department of Anatomy and Neurobiology, Northeast Ohio Medical University

In his landmark 1975 paper, "Functional Adaptations of Primate Molar Teeth", Kay emphasized the distinctive bilophodont structure of OWM molars, which have enhanced shearing capacities, expanded crushing surfaces and increased wear potential. The adaptive significance of this molar structure is the potential to more finely comminute foods, thereby increasing digestibility and energy gain, particularly from fibrous foods. We evaluate whether adult cercopithecines are further distinguished from other anthropoids in additional aspects of feeding-system morphology. A PCA of mandibular dimensions distributes taxa by size along PC1 (96% of variance) and separates large papionins (baboons and drills) from other anthropoids along PC2 (1.3% of variance). The strongest positive loadings are associated with mandibular length and symphyseal dimensions and strongest negative loadings associated with condylar dimensions. Allometric increases in symphyseal curvature with increasing jaw length are expected to distinguish larger papionins from other anthropoid primates, and to some degree from other cercopithecines. In a PCA of jaw-adductor fiber architecture, PC1 and PC2 account for 81.1% and 14.4% of the variance, respectively. Muscle size distributes taxa along PC1. The strongest positive loading along PC2 is associated with masseter PCSA, the strongest negative loading with masseter fiber length, but with less clear-cut separation of cercopithecoids from other anthropoids. A PCA of microwear variables distributes anthropoids along an axis of complexity (PC1) from tough- to hard-object feeders, and along an axis of heterogeneity (PC2) with platyrrhines generally more heterogeneous than catarrhines. Overall, unlike bilophodonty, musculoskeletal features and microwear do not clearly distinguish OWMs from other anthropoids.

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Introducing OH89, a new hominid clavicle from Olduvai Gorge, Tanzania

CATHERINE E. TAYLOR[1], FIDELIS MASAO[2,3], AGUSTINO V. SONGITA[3], GOODLUCK PETER[3] and LESLEA J. HLUSKO[1]

[1]Human Evolution Research Center, Department of Integrative Biology, University of California, Berkeley, [2]Department of History & Archaeology, University of Dar es Salaam, [3]Conservation Olduvai Project, Dar es Salaam, Tanzania

Over a century of paleoanthropology at Olduvai Gorge has yielded remarkable insight into the last two million years of human evolution in eastern Africa. These sediments continue to produce new fossil and archaeological evidence. We present the first public description of a clavicle recovered in 2005 by the Conservation Olduvai Project. The clavicle derives from sediments near the FLK North archaeology locality in Upper Bed I, just below Tuff IF. This tuff has a radiometric date of 1.785 Ma, indicating that the sediments are slightly older. OH89 is a fragment of a right clavicle, preserving the lateral half broken near the midshaft. There is some damage to the acromial end. In comparison to other hominid and modern human clavicles, this specimen falls towards the larger end of the spectrum, with a relatively robust shaft and rugosity for attachment of the deltoid. Upper Bed I sediments have yielded evidence of two hominid taxa, *Paranthropus boisei* and *Homo habilis*. To date, no clavicles have been recovered alongside craniodental material that would confidently associate the clavicle morphology with a particular taxon at Olduvai, however, we will provide detailed comparisons with relevant specimens recovered from other sites known to represent *Australopithecus afarensis, H. habilis, H. erectus,* and others.

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Sex Estimation from Carpals in an American White Sample

KATHRYN R. TAYLOR[1] and MICHELLE D. HAMILTON[2]

[1]Anthropology, State Center Community College District, [2]Anthropology, Texas State University: San Marcos

Estimating the sex of an individual is an important aspect of the biological profile in both forensic anthropology and bioarchaeology. When the skeleton is fragmentary or incomplete, traditional methods of sex estimation may not be possible,

and as such alternative methods need to be developed and tested. Carpal measurements are one such alternative method, originally developed by C.E. Sulzmann and colleagues in 2008. Carpals, while small and sometimes not recovered from outdoor contexts, are nevertheless compact dense bones that are unlikely to fragment. Testing 34 measurements on a sample of 80 modern White Americans (40 males and 40 females) from the William M. Bass Donated Skeletal Collection and the Texas State University Donated Skeletal Collection found that all measurements are statistically significant for normality and sexual dimorphism. Since asymmetry was found in 18 of the 34 measurements all further statistical analysis was completed for the right and left sides independently. With each measurement a univariate sectioning point was calculated to allow researchers to estimate sex in the field with minimal equipment. The univariate sectioning points have accuracy rates ranging from 47.5% to 88.75%. Multivariate stepwise discriminant analysis was also calculated to determine the strongest combination of measurements to use, resulting in accuracy rates ranging from 82.5% to 92.5%. Based on these data, carpal measurements are an acceptable alternative method for sex estimation when traditional methods cannot be employed. Future testing should examine the validity of these measurements with different ancestry and temporal groups.

Craniofacial Facial Morphology of the First Floridians

SARAH E. PRICE[1], MONICA FARALDO[1], LINDA L. TAYLOR[1] and GABRIEL A. CARDENAS[2]

[1]Anthropology, University of Miami, [2]Public Health Sciences, University of Miami

Significant debate continues on the sources and timing of the peopling of the Americas as new materials are discovered and evaluated. Census seems to be Asian origin for early immigrants into the New World, arriving in several waves. We hypothesized that the earliest Floridians would exhibit traits of Asian ancestry and would be homogeneous given the relative contemporaneity of our dataset. To test these hypotheses, we gathered data on skulls from five early human sites in Florida: Bay West (~6830 BP), Little Salt Spring (~6180 BP), Republic Groves (~6520 BP), Warm Mineral Springs (~10500 BP), and Windover (~8120 BP). We measured and analyzed 31 variables and 1 cephalic index to determine ancestry and the presence or absence of unique groups across the sites. Our data show these skulls exhibit traits which support shared Asian ancestry for all five: pronounced supraorbital notches or foramina; wide, flaring mandible; moderately narrow nasal aperture; and, broad overall facial shape. An ANOVA suggests four closely-related subgroups within our sample (Bay West, Little Salt, Warm Mineral Springs, Republic Groves), and one distinct outlier (Windover) (p=0.076). These results suggest that four populations were quite similar to one another, despite representing the oldest and youngest material. Windover data suggest that those people were also from Asia, but may have been separated from the parent population long enough to develop discrete craniofacial morphology. This difference may represent separate immigrations. Ultimately, our planned DNA analysis will help determine ancestry and degree of relatedness among these peoples.

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Lingual Tilting of the Molars among Early Hunter-Gatherers in South Central North America

MATTHEW S. TAYLOR

Department of Sociology & Anthropology, Georgia Southern University

Lingual tilting is a dental condition defined as the dislocation of the molars in a lingual direction resulting in an enlarged occlusal surface. Several incidences have been previously reported among early (5000 – 500 BP) hunter-gatherer populations from the Western Gulf Coastal Plain of North America. However, no systematic analysis of the phenomenon has been carried out in the region, nor have any comparisons been made with contemporary farming populations. The purpose of this presentation is to examine the prevalence and geographic distribution of lingual tilting of early forager populations (n = 461) in south-central North America, and provide explanations for its presence or absence. To better understand the phenomenon in hunter-gatherers, results are compared with adjacent populations (n = 233) of early farmers (1200 – 500 BP) representing the American Southwest, Great Plains, and Mississippian culture areas. While lingual tilting was found in low frequencies in a geographically widespread sample of hunter-gatherers, it was not observed among agriculturalists. The phenomenon is likely the result of a combination of factors: severe occlusal wear, resorption of alveolar bone, biomechanical stress placed upon the first molars, advanced old age, and a hunter-gatherer subsistence pattern.

Analysis of Neanderthal Biodistance using Non-Metric Features of the Dentition

MICHEL TCHANG

Anthropology, St Cloud State University

Within the context of the broad Neanderthal geographic distribution and past climatic fluctuation, researchers hypothesize that Neanderthals might demonstrate local, morphological variations. For instance, Fabre et al. (2009) have defined three "classic Neanderthal" subgroups from the East, South and West. This study investigates the occurrence of population-level trait variation in dental characters, their potential for identifying Neanderthal subgroups, the presence of east-west incline, and population movement patterns.The method used was the biodistance analysis, which uses the variation in phenotypic characters reflecting the genetic relationships as well as the non-metric observations, which evaluate the character frequencies based on the presence or absence of a feature.Results confirm the existence of three subgroups, as suggested by Fabre et al. with a one exception. The North population can be further divided into western and central regions, thus suggesting an east-west clinal distribution of Neanderthal dental traits. Differences between western and central European populations are consistent with a "re-colonization" suggested by Van Andel et al. and Voisin. In particular, these data show that during OIS-3, the western European Neanderthals were different from the eastern Neanderthals which may have undergone independent evolutionary processes, including gene flow with modern Homo sapiens. In contrast with the populations in the east and west, results indicate that Neanderthal populations in southwest of France remained stable and relatively homogeneous from OIS-5 through OIS-3.

The results support previous researches and adds resolution to our understanding of Neanderthal evolution across space and through time.

Fecal Cortisol Reflects Season, but not Habitat Degradation, in Folivorous Diademed Sifakas (*Propithecus diadema*)

STACEY R. TECOT[1,2], JEAN-LUC RAHARISON[3] and MITCHELL T. IRWIN[4]

[1]School of Anthropology, University of Arizona, [2]Laboratory for the Evolutionary Endocrinology of Primates, University of Arizona, [3]Département de Biologie Animale, Université d'Antananarivo, [4]Department of Anthropology, Northern Illinois University

Glucocorticoid levels are used to assess the effects of habitat disturbance on population health. However, they have been found to be higher, lower, or no different in disturbed and undisturbed habitats, and both high and low levels may indicate a variety of fitness-enhancing and fitness-lowering states. It is therefore imperative to collect contextual information alongside glucocorticoids. We investigated fecal glucocorticoid (fGC) levels in eight diademed sifaka groups, spanning a gradient of habitat disturbance, at Tsinjoarivo, Madagascar over one year. Known nutritional intakes and physiological and behavioral differences between continuous (CONT) and fragmented (FRAG) forest groups suggest that habitat disturbance reduces health. Using linear mixed models, we asked: (1) is there a lean season increase in fGC, presumably reflecting

nutritional stress; (2) do FRAG groups exhibit higher fGC levels; (3) does fGC level vary inversely with fruit availability, feeding time and/or degree of frugivory; (4) do FRAG groups and/or different demographic classes experience a different magnitude of lean season increase? fGC levels were highest during fruit scarcity in both sites, with a higher magnitude increase in CONT groups, and a lower magnitude increase for adult females relative to groupmates. However, models yielded only season and age class/season interaction as the only significant predictors of fGCs. Finally, degree of frugivory and daily feeding time both correlated negatively with fGCs at a daily level. As in red-bellied lemurs, individuals in disturbed habitats may have a muted fGC response to the chronic challenge of past environmental change and altered resource availability.

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Have you read the American Journal of Physical Anthropology? Clark Spencer Larsen and paradigm shifting research in bioarchaeology

DANIEL TEMPLE

Anthropology, George Mason University

Bioarchaeology emerged as an application of methods from skeletal biology to cultural ecological and processual archaeological paradigms. This emerging discipline sought to dislodge racialized approaches and interact with questions derived from anthropological and evolutionary theory. Clark Spencer Larsen (CSL) was at the forefront of this research. To date, CSL published 63 peer-review journal articles and 135 book chapters. CSL began his career (1981-1993) publishing articles (n = 13) and book chapters (n = 25) that addressed functional adaptation, diet, and stress and disease within the context of the agricultural transition and European colonialism in the Georgia Bight region of North America. Towards mid-career (1990-2003), CSL published a number of edited volumes that addressed methods in bioarchaeological research as well as those that interacted with paradigms surrounding contact and subsistence transitions (n = 6). As editor of the American Journal of Physical Anthropology (2001-2007), CSL oversaw the most substanitive increase (13%) in the publication of hypothesis-driven research in a generation. CSL has also authored books emphasizing the practice of bioarchaeology for professional audiences (n = 9) and the public (n = 1). Finally, as an educator, CSL mentored doctoral students with a reputation for research that challenged existing paradigms in diverse areas of bioarchaeological research (n = 21). On this basis CSL is one of the preeminent scholars in bioarchaeology: he has produced high quality research and public communications, and will continue to influence bioarchaeological research for many generations by imparting these values to a cadre of students.

Macaque Attack: Variation in craniofacial and TMJ shape in *Macaca fascicularis*

CLAIRE E. TERHUNE[1], CLAIRE A. KIRCHHOFF[2] and SIOBHAN B. COOKE[3,4]

[1]Department of Anthropology, University of Arkansas, [2]Department of Biomedical Sciences, Marquette University, [3]Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, [4]Morphometrics Group, New York Consortium on Evolutionary Anthropology

Though intraspecific variation in craniofacial and masticatory morphology can be considerable, most functional analyses focus on interspecific variation. Here we undertake an analysis of craniofacial and temporomandibular joint (TMJ) morphology in *Macaca fascicularis* with the goal of characterizing variation within this species and evaluating shape variation in relation to sex and cranial size. We further examine how aspects of craniofacial and TMJ shape covary. Three-dimensional models of 80 *M. fascicularis* crania were generated with an HDI 120 blue light scanner and geometric morphometric techniques employed to examine craniofacial and glenoid fossa shape variation. Principal component analysis, regression, and Procrustes ANOVA reveal significant variation related to allometry and sex in both craniofacial and (to a lesser degree) glenoid shape. In the cranium, much of the observed variation is related to length of the face and position of the tooth row relative to the TMJ and the masticatory musculature. Glenoid fossa width, length, and concavity varied considerably across specimens and in relation to size and sex. This variation has clear implications for masticatory efficiency and TMJ range of motion between sexes and across individuals of different sizes. Two-block partial least squares analyses further revealed a significant relationship between craniofacial shape and glenoid fossa shape, though only in males (females: RV=0.38, p=0.052; males: RV=0.63, p<0.0001). These findings allow us to examine covariation among multiple functional aspects of the bony masticatory apparatus, and further work will examine how craniofacial and glenoid shape vary in relation to dental morphology, wear, and craniofacial/dental pathologies.

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White-handed gibbon (*Hylobates lar*) great call note frequencies correlate with amplitude and entropy measures

THOMAS A. TERLEPH[1], SUCHINDA MALAIVIJITNOND[2] and ULRICH H. REICHARD[3]

[1]Department of Biology, Sacred Heart University, [2]Department of Biology, Chulalongkorn University, [3]Department of Anthropology, Southern Illinois University Carbondale

White-handed gibbons sing elaborate song duets featuring female great calls, vocalizations hypothesized to function in intrasexual territorial defense. The great call's climax reaches a higher fundamental frequency in young breeding adults than older females, suggesting a correlation with physical condition and thus resource holding potential. Higher pitched climaxes may indicate greater lung strength, as loud high-frequency note production depends on subglottal pressure. Although great call climaxes contain the highest notes of the females' vocal repertoire, and often exceed 100 dB SPL, the relationship between note frequency and amplitude has not been systematically explored. We analyzed great calls from 12 wild gibbon females at Khao Yai NP, Thailand. Note amplitudes correlated with fundamental frequency (R^2=0.49, F=9.6, p=0.01), and the call climax amplitude exceeded that of other parts of the call (F(2,22)=31.2, p<0.0001). We also correlated entropy with call note frequencies, because if great call climaxes are physiologically demanding, they should show greater entropy than lower-pitched parts of calls, as unstable, noisy vocal qualities correspond with an animal's vocal folds being taxed. When comparing the call climax's entropy with that of other portions of the call, we found that entropy increases with frequency (R^2=0.47, F=8.9, p=0.01) and that the entropy of the climax and a second high-pitched portion of the call exceed that of a lower-pitched part of the call (F(2,22)=29.3,p<0.0001). Our observations confirm that producing great calls is strenuous and probably evolved as an honest signal of female quality.

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Human and Nonhuman Primate Lineage-Specific Footprints in the Salivary Proteome

SUPAPORN THAMADILOK[1], KYOUNG-SOO CHOI[2], LORENZ RUHL[2], FABIAN SCHULTE[3], A. LATIF KAZIM[2], MARKUS HARDT[3], OMER GOKCUMEN[4] and STEFAN RUHL[1]

[1]Oral Biology, University at Buffalo, School of Dental Medicine, Buffalo, NY, [2]Cell Stress Biology, Roswell Park Cancer Institute, Buffalo, NY, [3]Applied Oral Sciences, The Forsyth Institute, Cambridge, MA, [4]Biological Sciences, University at Buffalo, College of Arts and Sciences, Buffalo, NY

Considering the primordial function of saliva in food preprocessing in the human oral cavity, surprisingly little is known about adaptive changes in saliva that may have occurred as a consequence of new dietary preferences adopted by humans during hominin evolution. Besides digestive functions, proteins in saliva are also needed for maintenance of tooth mineralization and protection from microbial pathogens. Novel insights into human lineage-specific

functions of salivary proteins and clues to their possible involvement in human disease can be gained through evolutionary studies, as recently demonstrated for salivary amylase AMY1 and salivary agglutinin DMBT1/gp340. However, the entirety of proteins in saliva, the salivary proteome, has not yet been investigated from an evolutionary perspective. Here, we performed the first comparative proteomics study between human saliva and the saliva of our closest extant evolutionary relatives, chimpanzees and gorillas, using macaques as an outgroup, with the aim to uncover features in protein composition that are unique to human saliva. We found that humans produce a waterier saliva, containing less than half total protein than great apes and old world monkeys. For all the major abundant salivary proteins expressed in humans, we could identify counterparts in chimpanzee and gorilla saliva. However, for most of these proteins, we discovered protein expression profiles in saliva of humans and nonhuman primates that appear to be species-specific. We predict that these differences likely reflect lineage-specific adaptations of human as well as nonhuman primate saliva to different dietary, environmental, and pathogen challenges that accompanied the evolution of each species.

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Moving forward with NAGPRA: From basic implementation to ethical engagement and collaborative reciprocity

JAYNE-LEIGH THOMAS

NAGPRA, Indiana University

The initial years after the passage of the Native American Graves Protection and Repatriation Act were marked by discord and conflict between tribal nations and the academic community, with members of both parties often seeing the other as adversaries. That the conflict was sometimes cast as 'science' versus 'religion' meant that basic implementation of the law was at times slow and defined by poor communication, mistrust, and controversy. A generation later, although the definition of what is considered ethical treatment of human remains continues to be debated, direct engagement with tribal communities has revealed that many possess strong interests in bioarchaeological research, provided relationships and trust has first been established. As new partnerships are being cultivated out of NAGPRA discussions, research is being developed that is both mutually beneficial and allows for participatory investigation. These types of projects not only provide a more enriching perspective, but are crucial for the field of bioarchaeology to continue to be relevant to those outside academia.

Recurrent Variational Ladder Auto-Encoders: An Unsupervised Deep-Learning Approach for Obtaining Structured Hierarchical Representations of Locomotor Characteristics from Sequential Kinematic Data

OSHANE O. THOMAS[1], ELIZABETH LEE[1], CHARLES C. ROSEMAN[2], SARAH P. PSUTKA[3], DANIEL E. LEIBERMAN[4], PIERRE MOULIN[5] and JOHN D. POLK[1]

[1]Department of Anthropology, University of Illinois at Urbana-Champaign, [2]Department of Animal Biology, University of Illinois at Urbana-Champaign, [3]Department of Urology, Northwestern University Feinberg School of Medicine, [4]Department of Human Evolutionary Biology, Harvard University, [5]Department of Computer and Electrical Engineering, University of Illinois Urbana-Champaign

Distinguishing different motion patterns is an important challenge for explaining the relationships between form and function for the locomotor skeleton. Traditional studies use univariate, time-discretized parameters (e.g., stride length, duty factor) ignoring dynamic postural changes that occur during gait cycles. Here we test hypotheses that speed, gait, and training can be discerned from joint angular data from multiple gait cycles using Deep Recurrent Variational Ladder Autoencoders (rVLAE). These models yield time-invariant representations expressing the totality of movement. Using a Qualisys motion capture system, knee and ankle angular displacements were obtained from 1280 gait cycles of trained (n=9) and untrained (n=7) female subjects at treadmill speeds ranging between 1.2-5.5m/s. We trained rVLAE architectures of different depths and representational capacities. Each model was trained for 5000 epochs to minimize both squared-difference reconstruction and Kullback-Leibler divergence losses using the ADAM optimizer. The best-performing models feature high fidelity reconstructions of knee and ankle angle sequences at both training and test time. Different levels in the hierarchical rVLAE models reflect qualitatively different aspects of movement. We find that representations of these models allow for effective discrimination between trained and untrained runners and between walking and running at different speeds. This work demonstrates the ability rVLAE models to automatically discriminate between biomechanically meaningful behavioral phenotypes that can then be used to elucidate the relationships between behavior and morphology in humans and in other species.

Pathways linking birth practices and early health: Immune development and the gut microbiome

AMANDA L. THOMPSON[1,2], KELLY HOUCK[1] and HANNAH JAHNKE[1,2]

[1]Department of Anthropology, University of North Carolina at Chapel Hill, [2]Carolina Population Center, University of North Carolina at Chapel Hilll

Global increases in Caesarean-section prevalence have raised concerns that children are exposed to perinatal environments that are both evolutionarily novel and potentially detrimental for growth and development. Epidemiological studies have linked C-section delivery to increased risk for the development of inflammatory conditions including allergy, asthma, inflammatory bowel disease, and obesity during later childhood and adolescence. Yet, the pathways linking delivery type to these outcomes are not well understood in early life. We examine the association between delivery type and the development of immune function and the gut microbiome in infants, aged 0-2 (n=40), and young children, aged 2-6 (n=67), from the Galapagos, Ecuador. Differences in C-reactive protein levels and gut microbiota composition by delivery type were tested using linear and logistic regression models adjusted for child age, sex, breastfeeding, and current morbidity. Inflammation and microbiota differed between participants born by C-section and those delivered vaginally. C-section delivered infants were less likely to have elevated CRP (OR: 0.74, 95%CI:0.54,1.02) than vaginally-delivered infants, despite having a higher likelihood of morbidity (OR: 1.64, 1.22,2.21). Children delivered by C-section also had lower microbiota diversity with higher proportions of Bacilli and lower proportions Clostridia. These bacteria are associated with obesity and gut barrier function, respectively, suggesting that alterations in the gut microbiota associated with delivery type may impact gut health and metabolism. Our results document that C-section delivery is associated with differences in immune function and gut microbiota that persist across early childhood, highlighting the importance of perinatal exposures for long-term development and health.

This research was supported by the University Research Council, UNC Chapel Hill.

Preliminary Insights into Wildlife Exploitation in and around Kirindy Mitea, National Park

KATHARINE ETH. THOMPSON

The Interdepartmental Doctoral Program in Anthropological Sciences (IDPAS), Stony Brook University

Illegal hunting and the consumption of wildlife is one of the greatest threats to biodiversity, especially within areas of high species endemism such as Madagascar. However, wild-caught meat provides a key source of income and nutrition for impoverished communities in developing countries. We currently lack information on public health, socioeconomic well-being, and subsistence practices in rural populations around much of the island. Specifically, wildlife hunting in and around Kirindy Mitea National Park is poorly quantified and the driving socioeconomic

factors behind exploitation are unknown. Pilot work in July 2017 used focal group and individual interviews in two villages to elucidate trade-offs between livelihood strategies and wildlife exploitation. Self-identified hunters confirmed the on-going exploitation of both game and protected species; they also described commonly-used, species-specific hunting methods. Examinations of the osteological material associated with both hunting and non-hunting households confirmed the regular consumption of several reported game species. Group discussions indicated a narrative of seasonal climatic patterns that shape local economies and employment opportunities. Participants also reported that rising bandit activity blocked access to markets. Both periods of decreased income and increased criminal activity coincide with periods of increased reliance on wildlife harvests. Future work in the 2018-2019 field season will employ a mixed methods approach to explore these trends; this 12-month study will combine interviews and zooarchealogical investigation of the bones accumulating in and around villages to provide a holistic understanding of who consumes wildlife, how much, and why.

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Preliminary 3-D kinematic data of wild mountain gorilla terrestrial locomotion: using lab-based methods in ape environments

NATHAN E. THOMPSON[1], KELLY R. OSTROFSKY[2], SHANNON C. MCFARLIN[2], MARTHA M. ROBBINS[3], DANIELLE RUBINSTEIN[1] and SERGIO ALMÉCIJA[2,4]

[1]Department of Anatomy, NYIT College of Osteopathic Medicine, [2]Center for Advanced Study of Human Paleobiology, Anthropology Department, The George Washington University, [3]Department of Primatology, Max Planck Institute for Evolutionary Anthropology, [4]Institute Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona

Nearly all 3-D studies of primate locomotion have been performed in captive laboratory, zoo, or sanctuary environments. While laboratory and captive studies are ideal for maximizing control, comparability, accuracy, and repetition of study parameters (e.g. speed, locomotor mode), they are limited in terms of species and sample sizes, and may not be able to faithfully reproduce the spectrum of locomotor behaviors performed in natural habitats. Recently, advances in technology have opened the door to affordable and practical field kinematic data collection.

Here we provide an initial report on the 3-D kinematics of terrestrial locomotion in wild mountain gorillas from Bwindi Impenetrable National Park, Uganda, including several quadrupedal and one bipedal stride. We emphasize the overall workflow required to obtain data, and error rates encountered in our various field setups.

Four, five, or six tripod mounted GoPro cameras equipped with fixed focal length lenses were used to record 2.7k video and synchronized via a wireless remote and an audio syncing algorithm in the program 'Argus'. Calibrations were performed by passing a 0.5-meter wand through the travel paths of gorillas. Direct linear transformation coefficients were calculated using a sparse bundle adjustment algorithm in Argus, and error rates were calculated as re-projection errors and 'wand scores'. For our various camera setups, re-projection errors ranged between 0.7–8.0 pixels, and wand scores (% measurement error of wand length) between 0.9 and 1.8 were consistently achieved. We show that reasonably accurate field setups are possible, and discuss pitfalls and best practices of field data collection.

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The Role of Energy Status in Determining Childhood Growth Patterns in Western Kenya

VICTORIA A. TOBOLSKY[1], ANDREW YEGIAN[1], NICHOLAS HOLOWKA[1], JOSEPHINE JEMUTAI[2], TIMOTHY SIGEI[2], ROBERT OJIAMBO[2] and DANIEL E. LIEBERMAN[1]

[1]Human Evolutionary Biology, Harvard University, [2]Department of Physiology, Moi University

More people today are overweight or obese than underweight and, paradoxically, extremely high energy environments are associated with reduced adult stature. While the specific mechanisms underpinning truncations in growth in such environments are unknown, this phenomenon is most frequently observed in children exhibiting insulin resistance, or hyperinsulinemia resulting from reduced binding affinity for the hormone in a diverse array of tissues. The following study thus compared girls (ages: 10-12, mean = 11.5) living in a high energy, low physical activity environment (n =18) with girls living in a low energy, high physical activity (n = 20) environment in rural Western Kenya. We tested the hypothesis that children growing in different energetic environments would have different level of urinary c-peptide, a direct measure of energy status, even when controlling for covariates like fat mass or BMI. We also tested whether children growing in differing energetic environments have different growth rates that correspond to the bioavailability of insulin, as measured by c-peptide. We quantified several differences in urinary byproducts of bone growth: Type I collagen breakdown products (n-terminal telopeptide (NTX) and c-terminal telopeptide (CTX)); and osteocalcin, a bone-derived hormone. Results demonstrate that there are differences between both urinary c-peptide and markers of bone growth between the high available energy population versus the low energy available population, although statistical significance varied. These differences suggest that higher energy populations may exhibit higher levels of insulin that directly relate to differences in growth rate and potentially correspond with reduced stature among insulin resistant adolescents.

The aye-aye (*Daubentonia madagascariensis*) uses post-cranial musculature to modify bite forces during gnawing behavior

MAXX C. TOLER[1,2] and CHRISTINE E. WALL[2]

[1]Anatomy, Campbell University School of Osteopathic Medicine, [2]Evolutionary Anthropology, Duke University

When gnawing wood, observations of body movements suggest that *Daubentonia* uses its postcranial musculature to assist the jaw adductors in pressing its incisors into a substrate. These observations indicate that *Daubentonia* may use post-cranial musculature to modify the bite force vector by generating moments across the atlanto-occipital joint that would result in either flexion or extension of the head. This hypothesis leads to two predictions about the magnitude of the bite force on the maxillary (Max) compared to the mandibular (Mand) incisor: (1) there is a flexion moment and Max/Mand is >1.0, or (2) there is an extension moment and Max/Mand is <1.0. For bites generated by jaw adductors alone, Max/Mand should equal 1.

Bite reaction forces were measured independently and simultaneously from the maxillary and mandibular incisors of *Daubentonia* (N=4) gnawing on paired wood blocks bonded to Kistler Force Links (9317b). The 100 largest peak magnitude bite forces were selected for analysis. The mean Max/Mand ratio for these gnaws was 0.89 (StDev 0.08) with a range of 0.63-1.07. Of the top 100 gnaws, only 10 had a Max/Mand greater-than or equal to 1. These results support the hypothesis that *Daubentonia* modifies its bite reaction forces during wood gnawing, most frequently by generating an additional atlanto-occipital extending moment using post-cranial musculature. This ability to behaviorally alter the direction and magnitude of bite forces using the post-crania may be an underappreciated element of anterior tooth use in species that do extensive preparation of foods using their anterior dentition.

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The evolution of TLR7 and TLR8 in yellow fever virus endemic areas

NICOLE S. TOROSIN[1], PATRICE SHOWERS CORNELI[2] and LESLIE A. KNAPP[1]

[1]Anthropology, University of Utah, [2]Biology, University of Utah

In Misiones, Argentina, the howler monkey populations *(Alouatta guariba clamitans)* and (*Alouatta caraya)* were devastated first in 1965, and then in 2008-2009 by Yellow Fever Virus (YFV). Howler monkeys are the most susceptible to YFV of all primates and die within a week after infection. To better comprehend the relationship between immune function and genetic variation, we have employed a novel approach comparing TLR7 and TLR8 immune evolution in a non-human primate species, howler monkeys, to humans sharing the same pathogenic pressure and environment in rural Argentina. A field campaign in 2017 yielded samples from *Alouatta* individuals in three categories: those alive prior to the outbreak, those that died from the virus, and those that survived the outbreak, along with their progeny. Using these data, along with genetic data collected from *Alouatta palliata mexicana*, and published primate immune gene sequences, we found strong evidence of episodic positive selection on the branch separating howler monkeys from other primate species. We also examined allele frequencies of innate immune genes TLR7 and TLR8 from pre- and post-YFV outbreak howler individuals. Finally, using human genotype data from regions with historical YFV exposure, we are testing for positive selection in TLR7 and TLR8. We will compare post-YFV TLR7 and TLR8 alleles in the howler monkeys to human TLR7 and TLR8 to evaluate potential variants important in YFV susceptibility.

Embodying Intimacy: Cranial Vault Modification as Child Rearing Practice

CHRISTINA TORRES-ROUFF

Anthropology, University of California, Merced, Instituto de Arqueología y Antropología, Universidad Católica del Norte, Chile

The intentional reshaping of the head is a long and intimate process of inscribing cultural identity on the body and as such its study can be framed with questions of practice, the experience of cranial shaping, and the long-term commitment of the practitioners. While head shape reflects and conveys group identity, the shape itself is likely also tied to practice as regards the manner in which children's heads are bound, and could be influenced by any number of factors including lineage, and importantly, the use of proper head shaping technique.

I present data from 908 Middle Horizon (AD 500-1000) individuals from San Pedro de Atacama to determine societal patterns and focus on one of these nine sites (Solcor 3, n=119) to explore these issues in more detail. In the oases at this time, 44.7% of the population (406/908) displays modification, with a majority (66.3%; 269/406) favoring a practice that involved some type of stiff pad. While the practice was significantly more common among females (x^2=6.139, p=.013), that difference did not extend to type of modification.

Looking more closely at Solcor 3, which generally parallels larger patterns, I contextualized these results with sex, questions of biological relatedness, shape and intensity of modification, as well as elements of the shaping apparatus, people and objects with whom an individual shared their grave, and evidence of personal, gendered, or local signifiers. Integrating these data allows me to explore the subtleties of the practice of head shaping and the implications for the individuals involved.

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Evolutionary demography of age at last birth among the Mosuo: synthesizing approaches from human behavioral ecology and cultural evolution

MARY C. TOWNER[1], CRISTINA MOYA[2], ADAM Z. REYNOLDS[3] and SIOBHÁN M. MATTISON[3]

[1]Department of Integrative Biology, Oklahoma State University, [2]Department of Anthropology, University of California, Davis, [3]Department of Anthropology, The University of New Mexico

Cultural evolutionary theory and human behavioral ecology offer different, but compatible approaches to understanding human demographic behavior. For much of their thirty-year history, these approaches have been deployed in parallel, with few explicit attempts to empirically integrate them. As a case study, we test hypotheses drawn from both approaches to explore age at last birth among ethnic Mosuo agriculturalists of Southwest China. Household census data were collected over 9 months in 2008 in 12 villages, representing both patrilineal and matrilineal communities. Our analyses focus on 320 women who were at least thirty years old and had at least one child. We modeled age at last birth using cox proportional hazards models with a random effect added for village. Other covariates included reproductive cohort and village lineality (matrilineal or patrilineal). Model comparison shows the most support for a model incorporating both reproductive cohort and lineality of village, but little additional variance explained by village itself. We see a marked temporal decline in age at last birth, from a median age of 39 years old in the oldest reproductive cohort to 25 years old in the youngest. This shift corresponds to, but also may precede, government policies enacted to reduce population fertility, a top-down cultural evolutionary force. Age at last birth was also lower in patrilineal compared to matrilineal villages. This is consistent with some evidence of greater intergenerational conflict in such settings, but surprising given the low potential for reproductive overlap in such a low fertility setting.

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Sex differences in diet composition and oral processing behaviors in colobines in Taï National Park, Côte d'Ivoire

JORDAN N. TRAFF[1], FERDINAND OUORO[2], E. ANDERSON BITTY[3], DAVID J. DAEGLING[1] and W. SCOTT MCGRAW[4]

[1]Anthropology, University of Florida, [2]Behavioral Assessment, Taï Monkey Project, [3]Laboratory of Zoology and Animal Biology, Université Félix Houphouët-Boigny, [4]Anthropology, The Ohio State University

The Tai Forest in Cote d'Ivoire contains populations of three colobines, the olive colobus (*Procolobus verus),* black and white colobus *(Colobus polykomos)*, and the red colobus (*Piliocolobus badius)*. Their diets primarily consist of leaves, fruits, and seeds. These species are moderately sexually dimorphic, with *C. polykomos* as the most dimorphic and *P. badius* as the least dimorphic. We investigated differences in diet composition and oral processing behaviors between males and females of *P. verus*, and compare these to existing data on *P. badius* and *C. polykomos*.

Data were collected on *P. verus* from May 2016-May 2017 (N=378 scans). There was a significant difference in diet composition between males and females (G-test, P<0.01) with the largest differences seen in young leaves (M=47%, F=41%), seeds (M=14%, F=8%) and unripe fruit (M=17%, F=25%). No significant differences were found between overall masticatory effort (mastications per action) or effort within food types (G-test, P=0.8). *P. badius* sexes show no significant differences in diet composition or masticatory effort (G-test, P=0.07, P=0.76). *C. polykomos* sexes were found to have significant differences in diet composition, but no differences in masticatory effort (G-test, P<0.01, P=0.94).

Our study suggests that the sexes of the more dimorphic species have differences in diet composition, but not in overall effort. We hypothesize that these differences are present in those species because within a given food category, females select plants that are easier to process. This limits female diet choice compared to larger males, but reduces overall female energy expenditure during food processing.

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Metatarsophalangeal proportions of *Homo naledi*

SARAH TRAYNOR[1], AARON J. SAMS[2] and ZACHARY THROCKMORTON[3]

[1]School of Medicine and Public Health, University of Wisconsin-Madison, [2]Research and Development, Embark Veterinary Incorporated, [3]Biomedical Sciences and Research, Arkansas College of Osteopathic Medicine

Proportions of hominoid foot bones are influenced by the different functional requirements of arboreal and bipedal locomotion. The lengths of the toes appear to be an important aspect of the differing styles of bipedal locomotion in hominins, as modern humans have short, straight toes whereas some hominins had longer and more curved toes, including *Homo floresiensis* and *Australopithecus afarensis*. *Homo naledi*, represented by fossil samples from the Dinaledi and Lesedi Chambers in the Rising Star Cave, South Africa has a largely modern hindfoot and midfoot. Its proximal pedal phalanges are curved, but the relative lengths of pedal phalanges are unknown, because they cannot be associated with metatarsals, or in many cases even with ray number. Here, we assess the relative lengths of the proximal phalanges to the metatarsals in *H. naledi* using Monte Carlo resampling. The results indicate that the minimum proportions of both digits I and II are within the modern human distribution, falling at the 80th percentile, however digits III-V appear to be outside the human distribution. While these results may indicate fossil preservation bias or other sample-derived statistical limitations, they potentially raise the intriguing possibility of unique medial versus lateral pedal column functional evolution in *H. naledi*.

Alternative male mating tactics and paternity in wild northern pig-tailed macaques (*Macaca leonina*)

FLORIAN A. TRÉBOUET[1], SUCHINDA MALAIVIJITNOND[2,3] and ULRICH H. REICHARD[1,4]

[1]Anthropology, Southern Illinois University, Carbondale, USA, [2]Biology, Chulalongkorn University, Bangkok, Thailand, [3]National Primate Research Center of Thailand, Chulalongkorn University, Saraburi, Thailand, [4]Center for Ecology, Southern Illinois University, Carbondale, U.S.A.

In multi-male primate groups, it is common for high male dominance rank to be positively related to access to fertile females. However, female reproductive interests and reproductive synchrony can also influence male mating tactics. These mechanisms often remain unknown due to the lack of genetic paternity analysis. We tested the relationship between dominance rank and paternity in a group of wild northern pig-tailed macaques (*Macaca leonina*) at Khao Yai National Park, Thailand. Sexual behavioral data, collected over 16 months, included genetic paternity analysis of 24 offspring. The alpha-male monopolized most, but not all, matings and sired 33% of the females' offspring. The two second-highest ranking males each sired 8% of the offspring, and one subordinate subadult male sired 4% of offspring. Unexpectedly, at least four different solitary extra-group males fathered 46% of the offspring. Among resident males, reproductive success was skewed towards the alpha-male (Nonac's *B* index=0.201, p=0.002). However, when more than one female was simultaneously receptive, the alpha-male was unable to monopolize all females' mating. Subordinate males engaged in opportunistic and surreptitious mating to avoid direct competition with higher-ranking males. Additionally, most solitary males who mated with females did so out of resident adult males' sight and after females approached them. However, a few solitary males mated in full sight of resident adult males. Genetic paternity analysis demonstrates the effect of alternative male mating tactics. In addition to male dominance, paternity is highly impacted by the number of simultaneously receptive females and probably female mate choice.

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Identifying intentional dental ablation: An assessment of diagnostic criteria using non-human primates

KENNETH G. TREMBLAY and SCOTT E. BURNETT

Department of Anthropology, Eckerd College

Intentional dental ablation, the purposeful removal of healthy teeth, is difficult to identify archaeologically due to varying causes for the antemortem absence of teeth, including trauma, disease, and agenesis. Researchers frequently use some combination of six criteria to identify ablation: the loss of anterior teeth, the lack of disease and trauma as causal factors, the symmetry of tooth loss, the degree of alveolar healing, and the spacing of teeth. This variation in diagnostic criteria hinders comparisons across researchers and may result in over or undercounting ablation depending on whether more liberal or conservative methods are employed. To assess the effectiveness of different methodologies in identifying ablation, we observed the dentition of 849 non-human primates at the National Museum of Natural History (Washington D.C.); 122 exhibited antemortem tooth loss or agenesis. This latter sample was examined for all six criteria to test for false positives, since the cultural practice of intentional tooth ablation is not found in non-human primates. Seven combinations of criteria were tested, based on published methods. Out of the 122 specimens, more liberal methods combining 3-4 criteria incorrectly identified ablation in 3-18 cases (mean=10), whereas moderate methodologies using five criteria identified 2-8 cases (mean=5). Overdiagnosis was most common when symmetry was excluded from consideration. Conservative assessment including all six criteria still identified ablation in one specimen. This research demonstrates the effect of variation in the methods used to identify dental ablation and highlights the need for both careful study design and caution when comparing published ablation frequencies.

New Perspectives on Past Healthcare: Challenges and Opportunities for Bioarchaeological Analyses of Population Level Healthcare in the Past

LORI A. TREMBLAY[1] and ALECIA A. SCHRENK[2]

[1]Department of Anthropology, The Ohio State University, [2]Department of Anthropology, University of Nevada, Las Vegas

The Bioarchaeology of Care framework, and the subsequent Index of Care, developed by Lorna Tilley was designed for individual level analyses of care provisioning and receipt in past populations. However, it is crucial to develop a model that will allow for population-level analyses of health-related care to truly understand the complexities of caregiving in the past at the community level. The impact of disease and disability extends beyond that of just the individual affected by causing significant effects on entire communities as well as on specific subgroups of a community. While developing a population-level Bioarchaeology of Care approach may have its methodological challenges, it nonetheless has the potential to allow researchers to obtain a more in-depth understanding of the complexity of health care provisioning in the past as well as to provide insight into the evolution of those practices and how they relate to and inform contemporary health care provisioning.

Galen, macaques and the growth of the discipline of human anatomy

GORAN TRKALJ

Department of Chiropractic, Macquarie University

Experimenting on non-human primates and using them as models to understand biology and behaviour of *Homo sapiens*, epitomized in the last eight decades by research carried out in the Cayo Santiago rhesus monkey colony, has had a long history. The first cases of such primate studies could be traced in Antiquity, to the origins of anatomy, one of the oldest scientific disciplines. These early anatomical studies are best represented in the work of Greek physician Galen of Pergamon (129 - *circa* 200/216 CE), whose ideas dominated Western medicine and the discipline of anatomy deep into the Renaissance period. While dissections were early recognised as the most appropriate method to study the structures of the human body, they were in Antiquity, due to cultural constraints, rarely performed on

humans. Galen studied various animal species to get insights into human anatomy, but found that primates provided the best models. Two primate species were most commonly dissected and vivisected by Galen - *Macaca sylvanus* and *Macaca mulatta*. While study of macaques enabled many valuable insights into human anatomy, it also led to various mistakes and simplifications. Many of Galen's experiments were carried out as public demonstrations with the then acceptable lack of compassion for animal suffering. This not only satisfied the thirst for knowledge but also the morbid curiosity of spectators. Galen's work bears many commonalities with modern science and is valuable in reflecting research ethics, methodological rigour as well as the influence of social context and cultural values on the scientific process.

Making sense of medieval mouths: Patterns of oral pathologies in a Late Medieval Italian skeletal sample

TRENT M. TROMBLEY[1], SABRINA C. AGARWAL[1] and PATRICK D. BEAUCHESNE[2]

[1]Anthropology, University of California, Berkeley, [2]Anthropology, University of Michigan, Dearborn

Numerous bioarchaeological and clinical studies have demonstrated sex differences in oral pathology frequencies, with females in particular having much higher prevalence of carious lesions compared to males. These observed differences are often thought to be the result of reproductive ecology with post-reproductive changes to hormonal imbalances in females, ultimately resulting in reduced salivary production, flow, and quality. This abrupt change in salivary production and quality is thought to result in a reduction of salivary buffering, thus exposing female oral cavities to higher likelihoods of contracting oral pathologies. We test the hypothesis that females have a higher likelihood of demonstrating carious lesions and other oral pathologies in a Late Medieval (A.D. 1350-1500) Italian skeletal sample of consisting of n = 95 individuals (n = 48 males, n = 47 females). For each individual we analyzed a total of 5 oral pathologies: antemortem tooth loss, carious lesions, periodontitis, abscesses, and calculus buildup while simultaneously noting severity and location throughout oral cavities. Employing both two-proportion z-tests and Relative Risk ratios, we found no statistically significant differences between males and females for any oral pathology. Although unexpected, these results are discussed in relation to: further clinical literature on age and sex-related differences in salivary production and quality, previous isotopic research on dietary patterns on the skeletal sample, and finally archaeological and historical evidence for medieval oral hygienic practices. Results suggest that oral pathologies, although impacted by reproductive ecology, might additionally be affected by hygienic and dietary factors.

Craniometric variation and taxonomy in papionin monkeys: the case of *Parapapio*

AMBER E. TRUJILLO[1,3] and CHRIS GILBERT[2]

[1]Department of Anthropology, New York University, NYCEP, [2]Department of Anthropology, Hunter College, NYCEP, [3]Department of Anthropology, Center for the Study of Human Origins

The lower level taxonomy within the fossil papionin genus *Parapapio* has been debated for many years. Most authors accept at least three species in the South African Plio-Pleistocene, separated, in part, by significant differences in molar size: *Pp. jonesi*, *Pp. broomi*, and *Pp. whitei*. However, it is widely known that these taxa overlap in many craniodental features, leading some authors to question the number of taxa present. For example, a recent study used 17 measurements to investigate extant and extinct papionin cranial variation, finding that multivariate analyses failed to discriminate between extinct specimens generally argued to represent different species. Based on these results, it was hypothesized that either: 1) the fossil specimens in question encompass a single species rather than multiple taxa; or 2) the 17 cranial measurements used were not a plausible way to distinguish between species. We tested these two hypotheses by further analyzing the same variables and adding the extant papionin *Macaca* to the comparisons. Two multivariate analyses were conducted, one with raw measurements and one with size-corrected data. The resulting Principal Components Analyses and bivariate correlations were heavily influenced by body size, and the addition of macaques significantly reduced any discrimination between extant genera and species. Specimens assigned to the genus *Parapapio* spanned multiple extant genera and species in PC space, providing no reason to assume only one species is present. In sum, our results support the hypothesis that the cranial measurements used are not a plausible way to distinguish between many papionin species.

Evolutionary history and adaptation from high-coverage whole-genome sequences of the pygmy population of Flores, Indonesia

SERENA TUCCI[1,2], RAJIV MCCOY[3], BENJAMIN VERNOT[4], SAM VOHR[5], MATTHEW R. ROBINSON[6], CHIARA BARBIERI[7], WENQING FU[3], HERAWATI SUDOYO[8], PETER M. VISSCHER[6,9], GUIDO BARBUJANI[10], JOSHUA M. AKEY[1,2] and RICHARD E. GREEN[5]

[1]Department of Ecology and Evolutionary Biology, Princeton University, Princeton, United States, [2]Lewis-Sigler Institute of Integrative Genomics, Princeton University, Princeton, United States, [3]Department of Genome Sciences, University of Washington, Seattle, United States, [4]Department of Evolutionary Genetics, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany, [5]Department of Biomolecular Engineering, University of California, Santa Cruz, United States, [6]Institute for Molecular Bioscience, University of Queensland, Brisbane, Australia, [7]Department of Linguistic and Cultural Evolution, Max Planck Institute for the Science of Human History, Jena, Germany, [8]Genome Diversity and Diseases Laboratory, Eijkman Institute for Molecular Biology, Jakarta, Indonesia, [9]Queensland Brain Institute, University of Queensland, Brisbane, Australia, [10]Department of Life Sciences and Biotechnologies, University of Ferrara, Ferrara, Italy

Modern human pygmy populations are distributed globally, and their short stature is hypothesized to represent one aspect of a complex eco-geographic adaptation to rainforest or island environments. Despite the numerous genetic studies conducted on pygmies in Africa and Southeast Asia, to date, there have been no genome-scale analyses of the pygmy population living on the island of Flores (Eastern Indonesia). Intriguingly, this population lives in a village near the cave where remains of a small-bodied hominin species, *Homo floresiensis*, were discovered. Here we describe 10 high-coverage genomes from the pygmy population of Flores, as well as genome-wide data for over 2.5 million SNPs from 32 individuals. We leverage this data to infer the evolutionary history of this population, quantify levels of Neanderthal and Denisovan ancestry and investigate genomic evidence of recent adaptation. We estimate that the Flores pygmies harbor on average 47.5 Mb and 4.2 Mb of Neanderthal and Denisovan sequence, respectively. Further, we identify a strong signature of recent positive selection encompassing the FADS gene cluster (chromosome 11), likely related to diet. Finally, we show that the short stature of Flores pygmies arose from polygenic selection acting on standing variation segregating in other human populations. Our findings support the hypothesis that body-size reduction evolved multiple times on Flores - in distinct hominin species - and cast new light on the evolutionary processes that took the stage on this particular biogeographic setting.

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3D Mapping of the Hominin-Bearing Deposits and Associated Passages and Chambers of the Rising Star Cave System, South Africa

STEVEN J. TUCKER[1], ASHLEY KRUGER[1], MARINA C. ELLIOTT[1], BECCA PEIXOTTO[1,2], DIRK VAN ROOYEN[1], MATHABELA TSIKOANE[1], MAROPENG RAMALEPA[1], RICK HUNTER[1], ERIC ROBERTS[1,3], PAUL DIRKS[1,3], JOHN HAWKS[1,4] and LEE R. BERGER[1]

[1]Evolutionary Studies Institute, University of the

Witwatersrand, [2]Department of Anthropology, American University, [3]Department of Geoscience, James Cook University, [4]Department of Anthropology, University of Wisconsin-Madison

Improved mapping and three-dimensional modelling of critical areas of the Rising Star Cave System, have provided a clearer understanding of the forms and relationships of its hominin-bearing chambers and passages. The updated modelling and mapping reveals and clarifies the cave's complexity over previous models, particularly in the area around the Dinaledi Chamber system. We now recognize two hominin-bearing ante-chambers connected to, but distinct from, the main Dinaledi Chamber. In addition, the mapping has highlighted a network of small passages, some of which are also hominin-bearing, and with some containing rare non-hominin remains. We therefore consider it prudent at this time to consider these chambers, ante-chambers and passages as a chamber system rather than a single chamber, sharing the vertical openings in the area of the "Chute" (Dirks et al., 2015, 2017) as a probable source for externally derived materials. Each chamber, ante-chamber and passage potentially has its own formation history, a history which must be investigated both independently of, and in relation to that of the other areas. Our mapping and investigations have not revealed significant, if any, alternative entrances to the system other than those fissures in the Chute area. Evidence from excavation, and mapping of the sediments provide strong evidence that at least some of the hominins entered the system from the Chute itself, or very closely related passages. The new 3D modelling provides us with the ability to better explore and interpret the complex geological and taphonomic history of this interesting system and its infill.

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Analyzing skeletal frailty in Medieval Poland

ALEXANDRA TUGGLE, KATHRYN MARKLEIN and DOUGLAS E. CREWS

Department of Anthropology, The Ohio State University

In humans, stress and health are fundamentally intertwined. Recently, we proposed a skeletal frailty index (SFI) based upon clinical research methods. Such SFIs estimate somatic frailty by assessing acute and chronic skeletal lesions. Our hypothesis is that skeletal frailty, as estimated using a SFI, differed by both age and sex at the medieval Polish site Kaldus (n=108). During the 10th to 13th centuries, Kaldus was a regional economic center of Poland with an economy based on social and ethnic inequality and a population expressing a variety of religious and cultural practices. Relying on 11 biomarkers of frailty, we analyzed this sample for skeletal markers of lifetime stressors and used these to estimate skeletal frailty. Following excavation all skeletons were assigned to an age group: 18-25 (n=21), 26-35 (n=31), 36-45 (n=31), and >45 (n=25). In the full sample, SFI averaged 4.07 (range 0-9). Among men (n=56), SFI averaged 4.09 (sd = 1.93; range 0-8); among women (n=52), it was 4.04 (sd = 2.07; range 0-9; $p = 0.895$). SFI was lowest in the youngest age group, 2.43 (sd = 1.91; range 0-6) and highest in the oldest, 5.28 (sd = 1.43; range 2-9; $p < 0.001$). In these medieval skeletons, an 11-biomarker SFI shows no significant difference between those ascribed as male or female. However, frailty does differ significantly by age. Skeletal frailty as estimated from biomarkers of skeletal stress suggests these individuals were exposed to a harsh environmental setting during their lives.

Causes and Consequences of Cesarean Birth in Yucatec Maya Subsistence Farmers

SYDNEY TULLER[1], AMANDA VEILE[1,2] and KAREN KRAMER[3]

[1]Anthropology, Purdue University, [2]Center on Aging and the Lifecourse, Purdue University, [3]Anthropology, University of Utah

Cesarean birth rates are rising throughout the world, often following improvements in health care access and the subsequent medicalization of birth. It may also reflect biological changes due to globalization and the nutritional transition. Maternal stunting and obesity are rising. These in turn contribute to fetal macrosomia and cephalopelvic disproportion, both risk factors for cesarean section. However, the biosocial causes of rising cesarean rates are likely to be population-specific. To avoid detrimental mother-child health consequences of medically unnecessary cesareans, it is crucial to investigate its causes across a range of populations. We examine links between maternal stature, macrosomia, and cesareans in Yucatec Maya farmers. Their community saw improved health care access and the onset of the nutritional transition over the past 20 years. Despite short maternal stature, fertility has historically been high and maternal-infant mortality fairly low. Maternal obesity has increased from 1992 to 2010 and the cesarean rate rose from 4% (1982-1992, n=137) to 23% (2003-2013, n=79). We predicted that (population-specific) short maternal stature and fetal macrosomia would be associated with increased likelihood of cesarean birth. Maternal-infant demographic and anthropometric data were collected for 79 births (2003-2013) and analyzed using logistic regression. We find that a one-centimeter decrease in maternal height is associated with a 20% increase in the likelihood of cesarean. Macrosomia was not associated with cesarean birth, neither independently nor in conjunction with maternal height. Pregnancy complications may be rising due to increased maternal obesity without corresponding increase in stature. The role of physicians is also discussed.

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Contributors to cesarean section childbirth and ways to support mothers during the early postpartum period

KRISTIN P. TULLY

Carolina Global Breastfeeding Institute, Department of Maternal and Child Health, University of North Carolina at Chapel Hill

Rates of operative delivery are consistently higher than the World Health Organization determined is appropriate. This suggests that factors other than clinical indications contribute to cesarean section. Data presented here are from interviews with 115 mothers on the postnatal ward of a hospital in Northeast England during February 2006 to March 2009 after the women underwent cesarean childbirth. Using thematic content analysis, we found women's accounts of their experiences largely portrayed cesarean section as everything that they had wanted to avoid, but necessary given their situations. Many unscheduled cesareans were conducted without indications of fetal distress and most scheduled cesareans were not booked because of 'choice.' The authoritative knowledge that influenced maternal perceptions of the need to undergo operative delivery included moving forward from 'prolonged' labor and scheduling cesarean as a prophylactic to avoid anticipated psychological or physical harm. The findings suggest the 'need' for some cesareans is due to misrecognition of indications by all involved. The factors underlying many cesareans may be modifiable with improved education, conditions, and training. 'Thinking about yourself' was part of cesarean recovery. Infrequent infant feeding concerned mothers but also enabled rest. Other breastfeeding obstacles were maternal mobility limitations, positioning difficulties, and frustration at the need for assistance. Participants were confused about nocturnal infant wakings, leading many to determine that they had insufficient milk. For the majority of mothers, breastfeeding after a cesarean is affected by interrelated and compounding challenges. Postnatal unit bassinet innovation offers better support for mother-infant dyads after vaginal or cesarean childbirth.

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Investigating the relationship between stable nitrogen and carbon isotope ratios and bacterial infections in a pre-Hispanic population from the Peruvian Andes

TIFFINY A. TUNG, NATASHA VANG and MAYA B. KRAUSE

Anthropology, Vanderbilt University

The analysis of stable nitrogen and carbon isotope ratios can provide valuable insights into paleodiet and biological processes related to health and disease. Mammalian physiology influences how stable isotopes are integrated, distributed, and excreted in mineralized and soft tissues, and disease presence can affect those processes. As such, variation in $\delta^{15}N$ within a population may be related to differences in disease experience, not differences in diet.

We test the hypothesis that archaeological bone samples with lesions indicative of bacterial infections, such as possible cases of tuberculosis and brucellosis, will exhibit elevated $\delta^{15}N$ relative to samples that do not. Bone collagen from vertebrae with lesions and other non-pathological skeletal elements are examined. They are from the site of Huari in central Peru and date to ca. 1050 CE and ca. 1300 CE.

Results: Among 27 samples with lesions, the mean $\delta^{15}N_{coll}$=12.3‰ (sd=2.3) and the mean $\delta^{13}C_{coll}$=-11.7‰ (sd=1.4). Among the 43 bone samples with no lesions, the mean $\delta^{15}N_{coll}$=11.7‰ (sd=3.5) and the mean $\delta^{13}C_{coll}$=-11.9‰ (sd=1.7). These preliminary data show no statistically significant differences between those with lesions and those without in terms of the $\delta^{15}N$ (Mann Whitney U=501.5, Z score=-.9471, p=.342) and the $\delta^{13}C$ (Mann Whitney U=555.5, Z score=-.2956, p=.764). This suggests that the disease experience indicated by the bony lesions did not translate into a detectable nitrogen imbalance, at least as reflected in the bone collagen. Ongoing stable isotope analysis of an additional 65 samples with lesions from the same site will be further compared to these existing data.

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Diet and Nutrition across Five Millennia in the Cusco Region of Peru: A Multi-Isotopic and Osteological Reconstruction

BETHANY L. TURNER[1], VÉRONIQUE BÉLISLE[2], ALLISON R. DAVIS[3], MAEVE SKIDMORE[4], SARA L. JUENGST[5], BENJAMIN J. SCHAEFER[1], R. ALAN COVEY[6] and BRIAN S. BAUER[7]

[1]Anthropology, Georgia State University, [2]Sociology and Anthropology, Millsaps College, [3]Department of State, United States of America, [4]Dedman College, Southern Methodist University, [5]Anthropology, University of North Carolina Charlotte, [6]Anthropology, University of Texas Austin, [7]Anthropology, University of Illinois at Chicago

Bioarchaeologists have long been interested in the intersections of diet and cultural complexity in Andean foodways and their interplay with consumption, hegemony, and health. The Cusco region of southern Peru is best known as the heartland of the Inca Empire (520-418BP), but has a long history of social complexity and regional exchange, including colonization by the Wari Empire (1350-950BP) and *in situ* development in earlier periods. These cultural transformations occurred against a backdrop of economic complexity and regional exchange. Elucidating subsistence and mobility over time in the Cusco region is therefore critical to understanding the evolution of Andean polities and their locally-experienced effects.

This study presents carbon, nitrogen, and oxygen isotopic data from human remains at four Cusco-region sites: the hunter-gatherer site of Kasapata (6350- 4150BP, N=7); the village site of Yuthu (2350-2050BP, N=23); the Wari colony of Hatun Cotuyoc (1350-950BP, N=9), and the contemporaneous Middle Horizon village site of Ak'awillay (N=25). Key aims are to estimate diachronic shifts in foodways and nutrition, and those related to Wari control. Results indicate nearly-identical isotope values at Kasapata and Yuthu trending toward lower-trophic level C_3 proteins and C_3 energy sources, while values indicate mixed C_3/C_4 diets at Ak'awillay and diets dominated by terrestrial meat and C_4 foods at Hatun Cotuyoc. Interestingly, oxygen isotope values suggest water source variation consistent with minimal mobility at Kasapata and, rather than increased mobility, variation in cooking styles at Yuthu and Ak'awillay and *chicha* (maize beer) consumption at Hatun Cotuyoc.

Adolescent diet and nutritional deficiencies in Samburu pastoralists of Kenya

ERICA E. TYLER[1], BILINDA STRAIGHT[2] and CHARLES E. HILTON[1]

[1]Department of Anthropology, University at Albany-SUNY, [2]Department of Anthropology, Western Michigan University

Dietary changes are well established in East African pastoralists, beginning in the colonial period and accelerating over the past three decades. These changes have included reduced milk consumption and an increased reliance on agricultural products. At the same time, seasonal drought and periodic extreme drought create conditions of chronic food and water insecurity. Nutritional studies of Kenyan pastoralists indicate a pattern of slow growth and development in children and delayed pubertal onset in adolescents. As part of a larger project on pastoralist adolescent vulnerability and resilience, this study focused on diet and nutritional indicators in two northern Kenyan Samburu sites. One is a highland site more accessible to health care, food markets, and education; the lowland site has limited access to these services. Sampling followed the WHO definition of adolescence (10-19 years). Study participants for the June-July 2017 data reported on here included 162 adolescent males and females: highlands (n = 97); lowlands (n = 65). Variables measured included: body weight; height; middle arm circumference; hemoglobin (Hb) concentration, and dietary recall. For lowland adolescent males and females as well as highland adolescent males, 50% of the individuals fell below the cut-off levels for anemia. Additionally, statistically significant differences are seen in mean hemoglobin concentrations between highland and lowland adolescent females. Our presentation discusses cultural and dietary evidence to support a pattern of decreased adolescent access to nutrient-adequate foods alongside higher labor demands and mobility in the lowlands particularly. This will enhance biocultural understandings of contemporary pastoralist adolescence.

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Did Holocene Brazilian shellmound builders experience higher rates of trauma: a worldwide sample comparison

JANELLE A. TYLER[1] and MARK HUBBE[1,2]

[1]Anthropology, The Ohio State University, [2]Instituto de Arqueología, Universidad Católica del Norte, Chile

During most of the Holocene, fisher-hunter-gatherer groups in the southeastern coast of Brazil built extensive habitational sites from shells and other organic materials, generating large shellmounds. Shellmounds occur across most of the southern Brazilian coast, and range from massive sites to mounds only a couple meters in height. Previous studies have shown that shellmound builders have unexpectedly high prevalence of oral health markers, like caries and dental wear, when compared to other hunter-gatherers around the planet. Here, we explore if other aspects of life-style differentiate these groups. Specifically, we analyze the prevalence of trauma in a sample of 18 skeletons excavated from the shellmound Porto do Rio Vermelho 02 (PRV-2), inhabited from 1880± 50 to 1180 ± 50 B.P. The sample show a high prevalence of trauma, with 33.3% (6/18) individuals showing at least one healed fracture. When compared to a reference sample of 33 worldwide agriculturalist and hunter-gatherer series, PRV-2 falls on the higher end of both hunter-gatherer (min=9.4%, max=33.7%; avg=18.42%; n=5) and agriculturists comparative series (min=0.0%, max= 33.3%; avg=9.18%; n=28). We also compared PRV-2 with 13 populations that experienced periods of high interpersonal violence, and/or warfare (min=14%, max=100%; avg=45%). When compared to this group, PRV-2 fits towards the lower end of that group, even

though there is no evidence of warfare or interpersonal violence in the site, showing that even though PRV-2 did not experience periods of violence or warfare, they show higher rates of trauma than most of the reference populations around the world.

Family Tomb or Siege Victims? Bioarchaeology at Lachish (Tell ed-Duweir)

JAIME M. ULLINGER[1] and TRACY K. BETSINGER[2]

[1]Sociology, Criminal Justice, and Anthropology, Quinnipiac University, [2]Anthropology, SUNY-Oneonta

The site of Tell ed-Duweir contains ample evidence of an Assyrian siege in the Early Iron Age, associated with the campaigns of Sennacherib in 701 BCE at Lachish, including a siege ramp, slings, sling stones, and arrows, as well as an elaborate relief of the event inscribed on the walls of Sennacherib's palace. In addition, hundreds of individuals in several tombs, including Tomb 120, have been identified as the victims of Assyrian attack. Imaginative descriptions of people being thrown into a pit and heads rolling down a large pile of bones have been published. However, comparison with contemporaneous burials suggest that the tomb was not anomalous, nor the site for victims of a military campaign. Instead, evidence points to this being the tomb of a large extended family. The crania, mostly separated from the other bones, were likely intentionally placed on the tomb edge as part of a mortuary ritual. Nearly all of them lack antemortem or perimortem trauma. Further, dental morphological data indicate that many of the people interred in Tomb 120 were most likely biologically related. Absence or near absence of shoveling (0/17), interruption grooves (1/25; 4%), distal accessory ridge (1/10; 10%), cusp 6 (0/48), and cusp 7 (1/68; 1%) provide evidence of a relatively homogenous group, particularly when compared with the neighboring site of Tell Dothan, where those traits were more abundant. In addition, two individuals possessed a unique, previously undescribed trait, suggesting that they are very closely related. Other dental anomalies also indicate an endogamous group.

Does dental functional morphology in platyrrhine primates reflect food type or proportion?

PETER S. UNGAR[1] and MARK F. TEAFORD[2]

[1]Anthropology, University of Arkansas, [2]Basic Science, Touro University

Researchers have long recognized that dental topography reflects diet differences within higher-level primate taxa, including platyrrhines. It is less clear, however, whether morphological variation in occlusal form reflects food preferences, i.e., proportions of different food types eaten, or selection for fracture-resistant foods (like hard nuts or tough leaves), whether consumed regularly or only when weaker items (like soft fruits) are unavailable. This study compares occlusal topography of maxillary second molars of 341 individuals representing 16 species of platyrrhine from northeastern Brazil. Orientation patch count rotated (OPCR) and angularity (average slope of slope) values of digital elevation models derived from laser scans were compared 1) among species grouped by primary diet (fruits, gums, leaves, seeds), and 2) among frugivorous taxa grouped by secondary diet (hard objects, insects, leaves, seeds). Results indicate that OPCR and angularity measures are both insensitive to differences in gross wear level within species, allowing direct comparison of variably worn specimens. Primary diet groups differ significantly in both attributes, though gum, leaf, and seed eaters all fall nearly entirely within the frugivore bivariate space. On the other hand, among frugivores, there is clear separation among all secondary, or fallback, food types. These results suggest that occlusal topography of these platyrrhines likely relates less to whether foods are "preferred" or "fallback" than to the mechanical challenges posed by those items. In other words, dental topography may be selected for more on the basis of food types that have to be eaten than on their proportions in the diet.

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The inner ear of *Epipliopithecus vindobonensis*: preliminary results

ALESSANDRO URCIUOLI[1], MARTA PINA[1], SALVADOR MOYÀ-SOLÀ[1,2,3] and DAVID M. ALBA[1]

[1]Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, [2]Institució Catalana de Recerca i Estudis Avançats, ICREA, [3]Unitat d'Antropologia Biològica (Department de Biologia Animal, Biologia Vegetal i Ecologia), Universitat Autònoma de Barcelona

Although pliopithecoids are considered stem catarrhines, their phylogenetic relationships are not conclusively settled yet. We investigate the inner ear anatomy of *Epipioplithecus vindobonensis* (middle Miocene of Slovakia), which is the most completely known pliopitecid (including both craniodental and postcranial remains). The four available petrosal bones (from individuals II and III) of this species were scanned using high-resolution microcomputed tomography, and the inner ear (bony labyrinth) was digitally segmented, extracted and measured. Up to 15 measurements and 9 shape indices were taken. Hearing capabilities were evaluated based on cochlear length (low frequencies) and stapedial area (high frequencies). A Principal Components Analysis (PCA) was run based on three shape ratios and three body size-corrected allometric residuals of the semicircular canals, to ascertain the morphological similarities of *Epipliopithecus* among primates. The hearing capabilities of *Epipliopithecus* fall within the anthropoid range, very close to the condition of the Oligocene propliopithecoid *Aegyptopithecus*, thus being consistent with a stem catarrhine status. In turn, the bony labyrinth variables of *Epipliopithecus* more closely resemble those in extant hominoids than in cercopithecoids. In the PCA, *Epipliopithecus* clusters with extant great apes (closest to bonobos), and falls apart from monkeys and hylobatids. These results for the vestibular apparatus likely reflect a morpho-functional signal (probably related to positional behavior), rather than a close phylogenetic link. Our analyses are consistent with *Epipliopithecus* being a stem catarrhine with some orthograde behaviors (e.g., climbing), as suggested by some skeletal features, but discount the possession of gibbon-like ricochetal brachiation.

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Direct measures of total and resting energy expenditure among Shuar forager-horticulturalist children: Evolutionary and epidemiological implications

SAMUEL S. URLACHER[1], J. JOSH SNODGRASS[2], LARA R. DUGAS[3], LAWRENCE S. SUGIYAMA[2] and HERMAN PONTZER[1]

[1]Anthropology, Hunter College (CUNY), [2]Anthropology, University of Oregon, [3]Preventive Medicine and Epidemiology, Loyola University Chicago

Energy expenditure is central to many evolutionary and epidemiological models of childhood phenotypic plasticity and health. However, direct measures of energy expenditure among children from non-industrialized populations are scant, restricting understanding of the role of energy use in driving patterns of human phenotypic variation. We collected measures of total energy expenditure (TEE; via doubly labeled water) and resting energy expenditure (REE; via repeated respirometry) from 44 Amazonian forager-horticulturalist Shuar children (age 4-11 years) over a two-week study period. As predicted, Shuar children demonstrate considerably elevated TEE relative to estimates derived from standard WHO body-mass-based prediction equations (mean + 331 kcal/day or > 20%), a finding that appears to be driven predominantly by elevated underlying REE (mean + 293 kcal/day or > 25%). Differences in TEE and REE between the Shuar and children from industrialized populations are not apparent, however, in analyses controlling for fat-free mass (both $p > 0.1$), indicating that previously observed population-level differences in energy expenditure largely reflect differences in body composition. These findings suggest that the widely implemented prediction of child TEE and REE using measures of body mass substantially

underestimates energy use and daily energy requirements among non-industrialized, energy-constrained populations. The similarity in fat-free-mass-corrected TEE and REE found between the Shuar and industrialized references further implies that variation in lifestyle and pathogen load may not be consistently reflected in composite energy expenditure during childhood. This latter hypothesis can be explicitly tested using measures of Shuar physical activity and immune function collected contemporaneously with direct energetic measurements.

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Do the short die young? A comparative study of agricultural and hunter-gatherer children's growth patterns

BETHANY M. USHER[1,2], CHRYSANTHI VIOLATES[2] and DANIEL H. TEMPLE[2]

[1]Provost Office, George Mason University, [2]Sociology and Anthropology, George Mason University

Children found in cemeteries of various communities have, historically, been observed and studied as a representative, modern population, with biological anthropologists not acknowledging selective mortality nor identifying hidden heterogeneity in skeletal samples. In our earlier work, comparing the stature at death of children to that of adults from the same population has shown that they are not representative. Juveniles found in cemeteries of pre-industrial, agricultural communities are shorter than expected; yet, the ages where the greatest selectivity occurs varies between populations. Estimated stature was calculated from adult (Trotter & Gleser 1958 formulae) and subadult (Ruff 2007 formulae) femur lengths and compared to World Health Organization Growth Standards, with age-at-death estimated independently using dental development. In this study, this work is extended, comparing the patterns of growth from agricultural communities (Tirup, Denmark; Irene Mound, North America; San Cristobal, North America; Chiribaya, Peru) to hunter-gatherer populations (Point Hope, North America; Jomon, Japan; Baikal, Siberia; Windover, North America). Initial results reveal that children from hunter-gatherer settings tend to be representative of the adult populations, but age-specific selectivity still occurs. This global sample shows that subadult skeletons are not representative of the living children from these communities, but do not show a single pattern of selectivity or growth, either. Questions regarding the complicated relationship between selective mortality and life-history tradeoffs are explored in this study.

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Does pelvic morphology predict gut volume in humans?

JEANELLE UY[1] and JOHN HAWKS[1,2]

[1]Anthropology, University of Wisconsin-Madison, [2]Evolutionary Studies Institute, University of the Witwatersrand

The gut (gastrointestinal tract) is a unique example of a visceral structure that is thought to have driven changes to postcranial dimensions. Paleoanthropologists have long assumed that the ribcage and pelvis of fossil hominins can predict gut size; however, no data exist in the literature that directly links organ tissue (guts) to hard tissue (bones). The pelvis, for example, reflects constraints imposed by gestation, birth, and locomotion in addition to supporting the abdominal viscera. Here we present the first dataset collected to directly study covariance between the three-dimensional structure of the pelvis and gut volume. Using abdominal CT scans from adult male and female *Homo sapiens*, we measured the volume of the small and large intestines and compared these to shape variables from the pelvis. Controlling for body size, we found no covariance between pelvis shape and gut volume in the overall sample or within females; however, there is significant covariance between pelvis shape and gut volume within the male sample. Within females, pelvis dimensions and shape do not predict gut volume. Pregnancy is a metabolic and spatial constraint on gut morphology in females that is not a factor in males. We hypothesize that the difference manifested between males and females in the covariance of gut and pelvis morphology may be explained by the importance of pregnancy in females.

Genome-wide SNP loci reveal effects of habitat fragmentation on silvery brown tamarin (*Saguinus leucopus*) population structure

LINA M. VALENCIA[1], YULIET A. ACEVEDO-GARCÉS[2], IVÁN D. SOTO-CALDERÓN[2] and ANTHONY DI FIORE[1]

[1]Anthropology, University of Texas at Austin, [2]Laboratorio de Genética Molecular (GENMOL), University of Antioquia, A.A. 1226, Medellin, Antioquia, Colombia

Habitat fragmentation often results in the loss of genetic diversity in wild populations due to reduced gene flow and the increased potential for inbreeding and genetic drift. An understanding of how habitat change impacts the geographic structuring of genetic variation is important for predicting the effects of fragmentation on patterns of divergence and population persistence over time. In this study, we assessed the genetic variability and population structure in the endangered silvery brown tamarin (*Saguinus leucopus*), which is endemic to northern Colombia between the Magdalena and Cauca rivers, a region of historically intense human population growth and habitat conversion for farming and ranching. We used "double digest Restriction-Site Associated DNA sequencing" (ddRAD-seq) to identify and genotype 29,837 SNP markers from across the genomes of 78 individuals from 19 social groups of *S. leucopus* inhabiting a fragmented landscape in the southern distribution of the species. We found significant genetic differentiation between populations living in fragments of secondary forest distributed in a heterogeneous matrix of cattle pastures and residential areas. Pairwise Fst comparisons, Bayesian clustering approaches, and multivariate analyses all support the existence of five distinct genetic clusters connected by moderate levels of admixture. Our study provides insights into the population genetic structure of tamarins living in a human-modified landscape and will assist in the design of habitat corridors that promote connectivity for the species across this heterogeneous habitat. Moreover, we demonstrate the utility of genome-wide SNP data for recovering fine-scale population structure and potentially revealing cryptic substructure within local geographic regions.

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The Association between Aggression and the Gut Microbiome in Wild Chimpanzees (*Pan troglodytes)*

NEGIN VALIZADEGAN[1,2] and REBECCA STUMPF[1,2]

[1]Anthropology, University of Illinois at Urbana-Champaign, [2]Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign

Disruption of the gut microbiome in humans is associated with neurological conditions such as anxiety, depression, autism, schizophrenia and neurodegenerative disorders. Microbial dysbiosis is also linked to many behavioral changes in humans such as their effect on sociality, focused attention, reaction to stress, and temperament. However, associations between the gut microbiome, stress and aggression have not received much focus in non-human primates. In this study, we examined the relationship between fecal microbiomes and behavior with a specific focus on male aggression and female coercion in wild chimpanzees. We compared aggression and coercion rates among male and female chimpanzees with fecal microbiome composition using 16S rRNA sequencing. The data were collected in Kibale National Park, Uganda between the years of 2012-2017. Significant differences between the rates of aggression in males were associated with changes in the gut microbiota in chimpanzees. The results of this study may shed light on variation in the rates of male aggression and female coercion and to model aggressive behavior in humans and other closely related species.

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The potential of cranial reconstruction for osteological analysis and human identification

SATU VALORIANI and MATTEO BORRINI

Research Centre in Evolutionary Anthropology and Palaeoecology, School of Natural Sciences and Psychology, Liverpool John Moores University

Taphonomic factors affect the preservation of human remains that are frequently recovered fragmented from archaeological and forensic contexts. An incomplete or broken skull negatively influences a comprehensive skeletal examination for both biological profile analysis and trauma interpretation, as well as the conservation and display of the remains.

A reconstructive approach is proposed to allow anthropologists to gain all the information from the remains. Reversible B-72 paraloid glue mixed with acetone is used to place the fragments together, while a wax mixture is applied to reconstruct the missing parts and stabilise the skull. All the compounds used are reversible and the reconstruction steps are documented with photographs.

The reconstruction will guarantee not only a better conservation of the skull, but also a multidisciplinary examination (e.g. anthropometry, CT scan, facial reconstruction) and a possible museum display.

Cognitive maps and navigation patterns in black howler monkeys (*Alouatta pigra*) in Palenque National Park, Mexico

SARIE VAN BELLE[1] and ALEJANDRO ESTRADA[2]

[1]Department of Anthropology, University of Texas at Austin, [2]Instituto de Biología, Universidad Nacional Autónoma de México

Primates require cognitive skills that allow them to efficiently navigate and locate food resources. Two main mechanisms have been proposed to explain navigation patterns: (1) a route-based map based on a series of familiar routes that are used regularly; and (2) a coordinate-based map that allows an individual to encode and remember the location of feeding sites based on X and Y coordinates. During an 18 month-study (2016-2017) of five groups of black howler monkeys, *Alouatta pigra*, in Palenque National Park, Mexico, we evaluate which cognitive maps they use. We recorded travel routes between feeding sites, the angle of approach to feeding sites, and the reuse of routes. We calculated a circularity index for each route, the amount of overlap among routes, the number of routes used to reach feeding trees revisited more than once, and the location where route direction changed significantly. We recorded between 500-591 navigation events per group. The distance traveled was 5-462m. Travel routes deviated from a straight line an average of 50%. Overlap of the routes varied between 65-86% among the study groups, and groups could reach a feeding site from up to five different routes. An average of 34% (N = 91 of 268) locations where travel direction changed were near important feeding trees, which was significantly more than would be expected by chance (Chi square tests: $P < 0.05$). These findings suggest that black howler monkeys depend on a route-based navigation strategy.

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Is savannah food dustier? Comparisons of the external abrasive loads of chimpanzee plant foods

ADAM VAN CASTEREN, ELLEN SCHULZ-KORNAS and KORNELIUS KUPCZIK

Max Planck Weizmann Center for Integrative Archaeology and Anthropology, Max Planck Institute for Evolutionary Anthropology

Hard mineralized external particles have been shown to be very deleterious to teeth. Much discussion has arisen as to both the selection pressure this may have exerted on enamel and the influence these particles may have on the interpretation of dietary signals within dental tissues. Yet our knowledge of the distribution and morphology of dust particles on the outside of primate plant foods is limited. Here we used the plastic cleaning method to collect external abrasives from the exterior of chimpanzee foods (leaves, fruits). This was done in two contrasting environments: the tropical moist broadleaf forest (Ngogo, Uganda) and subtropical savannah woodland (Issa Valley, Tanzania) during dry seasons. We predicted that foods from the dryer and more open savannah woodland would have a higher particle density and display distinctive particle form compared to those of the forest. Preliminary results indicate that this may not be the case, because estimated density of particles per mm^2 was almost identical in both locales (Ngogo = 2222.7±1319.4 and Issa = 1861.5±1310.1). Gross particle morphology also shared remarkable similarities. At both sites particles showed wide size variation in maximum diameter (ranges Ngogo = 1- 119µm, Issa = 1-187µm) but the vast majority remained small (mean, Ngogo = 5.35±5.20 µm, Issa = 5.38±5.21 µm). These results indicate that despite substantial differences in precipitation and canopy structure Aeolian born dust on foods remained rather constant in the two chimpanzee habitats. Therefore dust has to be considered a source of abrasion even in closed and moist environments.

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The East Asian linguistic phylum: A reconstruction based on language and genes

GEORGE VAN DRIEM

Institute of Linguistics, University of Bern

The hypothetical East Asian linguistic phylum consists of four recognised language families: Austroasiatic, Austro-Tai, Trans-Himalayan and Hmong-Mien. The geographical distribution and the centre of diversity of each language family together with the relative chronology of branching of each of the four family trees permits inferences about the dispersal and likely geographical origin of each of these language families. Twenty years ago, it was observed that the global geography of language families often corresponded with the distribution of Y chromosomal markers. The ubiquitous albeit not universal correlation of paternal lineages with the geographical distribution of language families suggested that a subset of the paternal ancestors of many language communities also happened to represent the linguistic ancestors of these populations. The Austroasiatic, Austro-Tai, Trans-Himalayan and Hmong-Mien language families are each found to correlate with one of four subclades of the Y chromosomal haplogroup O occurring in high frequency in the modern populations speaking these languages. Data from both historical linguistics and population genetics enable us to present a reconstruction of the founding dispersals of these language families.

Divergent evolution of extracellular trapping in primates

KATHRINE VAN ETTEN[1], MINKYU WOO[1], NEGIN VALIZADEGAN[1], SUVANTHEE GUNASEKERA[1], YARAVI SUAREZ[1], BRIAN ALDRIDGE[2] and J. F. BRINKWORTH[1]

[1]Anthropology, University of Illinois Urbana-Champaign, [2]College of Veterinary Medicine, University of Illinois Urbana-Champaign

A distinctive feature of human immunity is high circulating levels of a mammalian white blood cell called a neutrophil. Short lived and highly reactive, neutrophils are key limiters of bacterial pathogens via a range of self-sacrificing activities, commonly expelling their chromatin in an antimicrobial process known as neutrophil extracellular trapping (NETing). Neutrophilia and NETing are energetically costly, requiring frequent cell replacement and appearing to contribute to diseases considered particularly human (Gram-negative bacterial sepsis, asthma). A possible reason for human neutrophilia is that the species has evolved divergent neutrophil responses that require higher numbers of the cell circulate for host protection. To address this possibility, we analyzed NETing in seven mammalian species. Cells were isolated from human, rhesus macaque, common marmoset, horse, cow, cat and rabbit via a density gradient, and stimulated with 1ng-1ug of lipopolysaccarhide (LPS) from *Eschericia coli* for 1 hour. Cell membranes and DNA were stained and visualized via fluorescent microscopy. dsDNA in supernatant was detected by pico-green assay. Strong interspecies

differences in reactivity were noted in the level of dsDNA expelled, the proportion of NETing cells and apoptosis. Primates exhibited considerable NETing sensitivity to even subclinical doses of LPS compared to other animals, with humans exhibiting the highest sensitivity. Moreover, genes engaged in NETing were found to be under positive selection in primates. These results suggest that neutrophil reactivity has diverged multiple times during primate evolution and that Gram-negative bacteria has played a substantial role in the evolution of a major compartment of human physiology.

A Cross-Species Study of Navigational Neurobiology in Primates

DAVID R. VANIER[1], SHERWOOD C. CHET[2,3] and JEROEN B. SMAERS[4]

[1]IDPAS, Stony Brook University, [2]Department of Anthropology, George Washington University, [3]Center for the Advanced Study of Human Paleobiology, George Washington University, [4]Department of Anthropology, Stony Brook University

Cross-species variation in navigational abilities informs on the multitude ways in which species interact with their environment, and thereby shape their own evolution. In anthropoids, a shift to patchier but more energy-rich resources has been proposed as a primary driver of brain expansion, and increased navigational ability has been regarded central to this transition. Recent neurobiological work located the neural substrate of spatial navigation to cells in subregions of the hippocampus. We investigated differences in the relative size of these hippocampal subregions across 43 primate species. A measure of relative size was obtained by scaling hippocampal subregions against the brainstem. This measure assures functional and developmental independence among scaling variables, accurately accounts for allometric scaling effects, and provides a valid proxy for selective investment. Based on the patchy resource hypothesis of brain expansion, we hypothesized that anthropoids possess larger relative hippocampal subregions compared to strepsirrhines. Results instead indicate that anthropoids experienced a selective decrease of hippocampal subregions relative to the strepsirrhine-like early primate condition. We discuss two alternative explanations. Either strepsirrhines indicate increased navigational abilities relative to anthropoids, or neural processing of navigational abilities in anthropoids became more corticalized. Humans deviate significantly from the anthropoid trend in demonstrating autapomorphic enlargement of hippocampal subregions, suggesting that humans may have co-opted this neural system for additional functionality. Neuroscientific work points towards human's greatly expanded capacity for mental time travel, which is controlled by the same hippocampal cells.

Investigating form-function relationships in the bonobo hand and thumb

TIMO VAN LEEUWEN[1], MARIE VANHOOF[1], JEROEN STEVENS[2] and EVIE VEREECKE[1]

[1]Biomedical Sciences Group, University of Leuven, Kortrijk, Belgium, [2]Centre for Research and Conservation, Royal Zoological Society of Antwerp, Antwerp, Belgium

The well-developed dexterity of the human thumb is associated with complex manual tasks and the ability to make and use tools, a key component of human evolution. The bonobo (*Pan paniscus*), the closest extant relative to modern humans, possesses a fully opposable thumb similar to humans. However, as bonobos use their hands for locomotion as well as for manipulation, there is a direct conflict between the locomotor and the manipulative function of the thumb. To understand how the hand and thumb are adapted to these conflicting mechanical demands, we investigated the functional anatomy of the bonobo hand using a unique sample of eight bonobo cadavers. We performed detailed dissections of unembalmed bonobo specimens, collecting quantitative datasets of the extrinsic and intrinsic hand musculature. We used medical imaging (CT) to obtain the 3D geometry of the trapezio-metacarpal joint while scanning in a range of functional positions allowed for investigation of the joint kinematics.

Our results show that the force-generating capacity of the extrinsic and intrinsic hand muscles in bonobos is largely similar to that of humans. However, in contrast to humans, bonobos show an increased functional coupling between the muscles of the thumb, index and lateral fingers. It is conceivable that not relative muscle development but rather differentiation and individualisation of the hand muscles explains the higher hand dexterity in humans compared to bonobos.

This study offers new insights in the relatively unknown bonobo anatomy and contributes to a better understanding of the evolutionary history of the primate hand and thumb.

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Unreciprocated assistance by male primates: ubiquitous sexually selected services

CAREL P. VAN SCHAIK[1], GRETCHEN F. WAGNER[2] and FILIPE C.R. CUNHA[2]

[1]Anthropology, University of Zurich, CH, [2]Animal Ecology, Netherlands Insitute of Ecology (NIOO-KNAW)

Because acts of assistance incur a direct cost, natural selection should favor these behaviors only when directed at kin or when reciprocated. However, males of many primate species provide unreciprocated assistance to other group members. The most striking cases of such services are observed in predation avoidance. We therefore conducted comparative analyses of published accounts of vigilance, mobbing, and counterattacks in nonhuman primates. We found a robust and significant male bias in all of them. We argue that this systematic sex bias represents costly signaling or alternative reproductive tactics, and thus reflects a form of sexual selection. Alternative explanations, such as reciprocation in other modalities (e.g. food sharing) or parental care, can often be excluded and are therefore unlikely to be the main driver of sex-specific asymmetry in anti-predatory behavior (and a variety of other male services) seen in primates. Instead, females derive direct benefits from preferring males that provide services, rather than indirect benefits from choosing ornamented males. We conclude that male services are a form of helping rooted in sexual selection that has so far been largely ignored. Our findings highlight the role of male services in human evolution, and stress parallels with the competitive altruism documented for modern men.

A fossil-based perspective on modern human pelvic sexual dimorphism

CAROLINE VANSICKLE

Anthropology, Bryn Mawr College

Modern human pelves have shape differences that make it possible to assess sex using skeletal remains; yet the same is not true for the pelves of chimpanzees, our closest living relatives. Pelvic sex differences in humans have typically been explained by female adaptations for birthing large-brained infants while retaining the ability to walk bipedally. Some researchers have gone so far as to predict that female morphology even limits locomotor efficiency; while others have more recently shown that humans do not experience energetic sex differences when walking. They have also suggested that bony pelvic constraints may have less of an effect on parturition than originally hypothesized.

Here I address the hypothesis that pelvic sex differences in humans evolved in response to obstetric demands. I compare measurements of the true pelvis (i.e. birth canal) between males and females of two populations of large-brained, bipedal hominins: modern humans and Neandertals. Since obstetric demands should be similar in these populations, the hypothesis will be supported if female pelvic form is similar in both populations, even if male pelvic form differs. Using bootstrap resampling to compare Neandertals and humans of the same sex, I found that in both males and females, Neandertals differ from modern humans. This preliminary (due to

preservation limitations in the fossil record) result potentially indicates that pelvic obstetric adaptations varied between different populations of large-brained bipeds. This interpretation would seem to complicate the explanation that modern humans have pelvic sex differences because of their obstetric demands.

Isotopic assessment of the Saladoid and post-Saladoid (AD 125-1395) remains from the Red House Site, Trinidad and Tobago

LAURA VAN VOORHIS[1], GEORGE D. KAMENOV[2], BASIL A. REID[3] and JOHN KRIGBAUM[1]

[1]Anthropology, University of Florida, [2]Geology, University of Florida, [3]History, The University of the West Indies

The Red House Site (SGE-51) in Port of Spain, Trinidad and Tobago, is a pre-colonial site that was inhabited ca. AD 125 to 1395. The site has yielded cultural material that dates to Saladoid and post-Saladoid contexts as well as human burials and the skeletal remains of at least 60 individuals. This research uses isotopic data for humans (n=38) and fauna, nine dogs and one collared peccary, to assess dietary ecology and mobility. Samples were assayed for light isotope ratios from bone collagen ($d^{13}C$ and $d^{15}N$), bone apatite ($d^{13}C$), and tooth enamel apatite ($d^{13}C$ and $d^{18}O$), as well as heavy isotope ratios from tooth enamel ($^{20n}Pb/^{204}Pb$ and $^{87}Sr/^{86}Sr$). Results support a C_3 and marine-based diet, with a small but statistically significant difference between Saladoid (n=9) and post-Saladoid (n=22) individuals. The $d^{13}C$ increase suggests a dietary shift from a more broad-spectrum terrestrial subsistence towards a more mixed C_3 and CAM-based subsistence with maritime foods. Similar $d^{15}N$ values between the two human groups underscore a consistently marine-based diet. Although Saladoid individuals show heterogeneity in strontium ratios, the observed ranges for both Sr and Pb are consistent with expected variability on Trinidad and Tobago. Despite a small sample size, different Pb ratios for males and females in the post-Saladoid group suggests a 'non-local' origin for several females. This could suggest that patrilocality was observed at the Red House site during the post-Saladoid period. Isotopic data presented are compared with broadly contemporaneous Caribbean sites to assess regional trends.

Feeding Romans in the Early Middle Ages: nutritional patterns in several Roman communities

SARA VARANO[1], FLAVIO DE ANGELIS[1], ANDREA BATTISTINI[2], WALTER PANTANO[2], PAOLA CATALANO[2], VALENTINA GAZZANIGA[3], CRISTINA MARTÍNEZ-LABARGA[1] and OLGA RICKARDS[1]

[1]Department of Biology, University of Rome "Tor Vergata", [2]Servizio di Antropologia, Soprintendenza Speciale Archeologia, Belle Arti e Paesaggio di Roma, [3]Department of Medico-Surgical Sciences and Biotechnologies, University of Rome "Sapienza"

Along the last decades several cemeteries dated back to the Early Middle Ages have been dug up in Rome, whose molecular evaluation could shed light on the lifestyle and health conditions of the medieval roman population. Remarkable changes and the arrival of foreign people occurred at the end of the Roman Empire leading to a crisis of the current economic systems that influenced the diet of the roman citizens.

This study aims to contribute at the characterization of the dietary habits of the medieval roman society through carbon and nitrogen stable isotope analysis performed on 150 human skeletal remains and several faunal bones, suitable to determine people ecological background.

The isotopic evaluation suggests the medieval Romans' diet was mainly based on terrestrial resources consumption, in particular C3 plants: highly protein resources intake seems to be restricted and both marine and freshwater foodstuffs consumption appears to be negligible resulting in an unbalanced diet between carbohydrate and protein rich foods.

To the best of our knowledge this research provides the first biomolecular data about the medieval roman population, representing an outstanding opportunity to support the biologic profile reconstruction of Romans in this chief transitional period featured by the downfall of the Roman Empire.

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Stacked investment in female *Colobus vellerosus*: what influences the timing and overlap of offspring?

JOSIE V. VAYRO[1], TONI E. ZIEGLER[2], LINDA M. FEDIGAN[1], ANGELA CROTTY[1], STEPHANIE A. FOX[1,3], EDITH POTVIN-ROSSELET[1] and PASCALE SICOTTE[1]

[1]Anthroplogy and Archaeology, University of Calgary, [2]National Primate Research Center, University of Wisconsin, [3]Anthropology, University of New Mexico, Albuquerque

Most primates produce one offspring at a time, but can overlap investment in consecutive offspring ('stacking' investment: van Noordwijk 2012). This primate reproductive strategy may vary depending on ecological or social conditions. We explored this possibility in a wild colobine. We extended van Noordwijk's definition to include overlap in reproductive states i.e. when a female conceives and gestates while an older infant is still in nipple contact. We collected 5820 contact hours, 562 hours of focal data, and 1866 faecal samples from 18 females *Colobus vellerosus* between May 2012 and 2013 at Boabeng-Fiema Monkey Sanctuary. We determined reproductive state from behavioural and hormonal data. We analyzed faecal samples for progesterone and oestradiol metabolites at the WNPRC. Infant age was inversely related to time spent in nipple contact ($p<0.001$, n=15). Females who stacked investment had a higher proportion of daily nipple contact with infants than females who did not ($p=0.045$, n=15). Female age ($p=0.730$, n=16), infant age ($p=0.173$, n=16), infant sex ($p=0.595$, n=15), and food availability ($p=0.325$, n=16) showed no effect on stacked investment. Females in stable multi-male groups stacked investment more than expected and females in unstable multi-male groups less than expected ($p=0.006$, n=16). Females in stable uni-male groups did not differ from expected frequencies. Instability in male group membership may affect female reproduction by increasing female stress levels and reducing feeding time. Our results also suggest that females who stack investment may be in better condition, and therefore have the extra energy required to stack investment.

Nutritional status of urban Cuban children and perceptions on obesity of a sample of their relatives

VANESSA VÁZQUEZ SÁNCHEZ[1], DULCE MILAGROS NIEBLA DELGADO[2], MARÍA ELENA DÍAZ SÁNCHEZ[3], YOANDRY A. DÍAZ RODRÍGUEZ[3] and ARIANNA CARREÑO NIEBLAS[3]

[1]Anthropological Museum Montané, University of Havana, [2]Philosophy and History Department, University of Havana, [3]National Institute of Hygiene and Epidemiology, Health Ministry

The goals of the study are to evaluate by anthropometry, the nutritional status of urban Cuban children aged 9- 12 years of four elementary schools of Havana province and one elementary school of Cienfuegos province, and to describe the family perceptions on obesity that have a sample of their relatives. Anthropometric measurements were weight and height. BMI was classified according to Cuban standards. Of the 577 measured students, 34.3% were overweight or obese. In the five schools were carried out discussion groups, with a total of 45 relatives, whose children were overweight or obese. These discussion groups were recorded and transcript for analyze the information. The relatives manifested feel blame and responsibility on the obesity of the children, because they don't educate them with appropriate alimentary habits and buy them trash food. They perceive physical exercises as a solution to the obesity, but they don't make it with their children. The factors more referred as influential on the obesity of children were: insufficient sport practice, excess of hours in front TV, computer and video games, irregular schedules of food consumption, and the economic crisis that affects the purchase of healthy foods. The relatives are not agree with the weight of their children and they refer that

children feel unsatisfied with their bodies, with low self-esteem and received jokes and suffer discrimination. They manifested concern with the proximity to the adolescence, and that's why is very important to promote the prevention of obesity in early ages.

Birth across the epidemiological transition: Implications for infant growth and gut microbiome assembly

AMANDA VEILE[1,2] and KAREN L. KRAMER[3]

[1]Department of Anthropology, Purdue University, [2]Center on Aging and the Life Course, Purdue University, [3]Department of Anthropology, University of Utah

Cesarean births are evolutionarily novel and epidemiologically associated with several negative child outcomes. Much data suggests that cesarean-born children develop gut microbiome profiles that predispose them to obesity. However, other studies found no difference in child gut microbiota or obesity after accounting for independent risk factors. We therefore examine infant gut microbiota and child growth in a Yucatec Maya community where cesarean births are rising (from 0% to 23% over the past 65 years), but where few childhood obesity risk factors exist. The Maya consume traditional diets, breastfeed >2.5 years, and have physically active childhoods. Despite these protective factors, we found 10% higher body mass in cesarean-born Maya children compared to vaginally-born Maya children by 5 years of age (n=108). We now report on a pilot study of 7 cesarean-born and 10 vaginally-born Maya infants (aged 0-1). We expected that cesarean-born children would have less microbial diversity than vaginally-born children. Fecal samples were collected twice over a 2-week period. Demography, infant diet, breastfeeding status, antibiotic use, and reason for cesarean were collected by maternal interview. Fecal samples were transported to Purdue University for high-throughput sequencing of 16S rRNA gene amplicons to identify microbial taxa. Preliminary analyses reveal that microbial diversity is lower in cesarean-born children. However, inter-individual, age, and diet-related differences in microbial diversity are also pronounced and obscure differences associated with birth mode. This ongoing research has potential to clarify the early-life biological mechanisms linking cesarean birth to childhood obesity.

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Interspecific and intraspecific variation in the use of manual touch during fruit foraging in primates

CARRIE C. VEILLEUX[1], CHIHIRO HIRAMATSU[2], KIM VALENTA[3], SHASTA WEBB[1], FILIPPO AURELI[4], SHOJI KAWAMURA[5] and AMANDA D. MELIN[1,6]

[1]Anthropology & Archaeology, University of Calgary, [2]Human Science, Kyushu University, [3]Anthropology, McGill University, [4]Instituto de Neuroetología, Universidad Veracruzana, [5]Integrative Biosciences, University of Tokyo, [6]Medical Genetics, University of Calgary

Manual discriminative touch, referring to the ability to detect shapes, textures, or vibration with the hands, is an integral component of primate foraging. Manual touch is critical for activities such as grasping food items and testing fruit ripeness. Although one of the defining trends characterizing primates is an increased emphasis on manual grasping, anatomical studies have identified variation in manual touch sensitivity and dexterity across primates associated with phylogeny and ecology. Yet, few behavioral studies have quantified the use of touch during foraging in wild primates. In this project, we used foraging behavior datasets from platyrrhines (*n*=3 species) and strepsirrhines (*n*=1 species) to investigate interspecific and intraspecific variation in the frequency of touch during fruit foraging. Our platyrrhine data were collected at Santa Rosa National Park in Costa Rica, and include over 6200 fruit feeding bouts by black-handed spider monkeys (*Ateles geoffroyi*), white-faced capuchins (*Cebus capucinus*), and mantled howler monkeys (*Alouatta palliata*). Our strepsirrhine data include brown lemurs (*Eulemur fulvus*, 1013 feeding bouts) from Ankarafantsika National Park in Madagascar. These species vary in degree of frugivory and anatomical correlates of dexterity. Among platyrrhines, we found significant interspecific variation in the proportion of foraging sequences that include manual touch even when feeding on the same fruit species (likelihood ratio test, $p < 0.0001$), with capuchins using touch more frequently than spider or howler monkeys. Further, we identified significant intraspecific variation within capuchins in the use of touch by age class ($p<0.0001$), with immatures using touch less frequently than adults or subadults.

A Comparative Study of Neandertal Hearing Using 3D Virtual Reconstruction

ALEX D. VELEZ[1], ROLF M. QUAM[1,2,3], MERCEDES CONDE-VALVERDE[4], IGNACIO MARTINEZ[2,4], MANUEL ROSA[5], CARLOS LORENZO[6,7] and JUAN LUIS ARSUAGA[2,8]

[1]Anthropology, Binghamton University, [2]Paleontologia, Centro de Investigación (UCM-ISCIII) sobre Evolución y Comportamiento Humanos, [3]Anthropology, American Museum of Natural History, [4]Ciencias de la Vida, Universidad de Alcalá, [5]Teoría de la Señal y Comunicaciones, Universidad de Alcalá, [6]Área de Prehistoria, Universitat Rovira i Virgili, [7]Paleoecología Humana, Institut Català de Paleoecologia Humana i Evolució Social (IPHES), [8]Paleontología, Universidad Complutense de Madrid

The study of the evolution of hearing in hominins offers important insights into the evolution of the special senses. Researchers have studied the ear structures in several hominin taxa, including early hominins and some Middle and Late Pleistocene *Homo* taxa. Traditionally, hearing is measured relying on behavioral tests in living subjects, but studying hearing in fossil forms relies on drawing inferences from the preserved anatomical structures of the ear. Recent studies on hominin hearing have used a biomechanical model, based on measurements of the ear structures, to calculate the sound power transmission through the outer and middle ear up to 5 kHz, and the results show a strong correlation with auditory sensitivity. Here, we extend this analysis to study the ear anatomy and audition in *Homo neanderthalensis*. In addition to measurements collected on specimens where the ear region is directly exposed, we made 3D virtual reconstructions, based on microCT scans of the temporal bones in two Neandertal individuals: La Chapelle-aux-Saints and La Quina H5. Aside from some aspects of the ear ossicles, the remaining anatomical dimensions of the ear structures showed no significant differences between Neandertals and modern humans. Similarly, the hearing pattern in the two Neandertal individuals is nearly identical to that found in the Atapuerca (Sima de los Huesos) hominins and differs from recent humans only at frequencies >4 kHz, where modern humans are more sensitive. Thus, the Neandertals were characterized by an ear anatomy and hearing abilities that are broadly similar to those of living humans.

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Evaluation of skin-related variants in African ancestry populations and their role in personal identification

VIRGINIA VELTRE[1], ARIANNA PARISI[1], FLAVIO DE ANGELIS[1], GIANFRANCO BIONDI[2] and OLGA RICKARDS[1]

[1]Department of Biology, University of Rome "Tor Vergata", [2]Department of MESVA, University of L'Aquila

Pigment-related genetic variants point out their role in personal identification as they can be considered predictors for Forensic DNA Phenotyping (FDP) and mounting evidence suggest their bio-geographic inferential power to gain information about the individual geographical origin. The current research aims to explore the allelic status in several SNPs mapped in selected genes known to be involved in skin pigmentation: *OCA2, HERC2, SLC45A2, SLC24A5* and a

novel intergenic region between *BEND7/PRPF18*. The genetic evaluation has been performed on 219 healthy people from African and African derived populations: Fon, Dendi, Bariba and Berba communities from Benin, Tuareg from Libya and Afroecuadorians. The genotypic results have been integrated with the available data from Phase 3-1KGP data release in order to obtain a selected populations panel and the HapMap project YRI, CHB, CEU, and MXL populations were used as an inferential model training set to test the likelihood of correct assignment to geographically differentiated human groups. Data reduction methods and two different classification algorithms based on Bayesian inference have been employed in order to compare the correct assignment likelihood. The proposed panel seems to properly interpret the geographic variation and some interesting evidence could be pointed out in African mixed populations, that seem to be differentially distributed if the total panel is considered. The results support the use of phenotypic inference by molecular information as an auxiliary tool in the personal identification through the use of bio-geographical ancestry information and outwardly visible characteristics such as dark skin tone.

Walking mechanics and the evolution of the human pygmy phenotype

VIVEK V. VENKATARAMAN[1], THOMAS S. KRAFT[2], ANDREW YEGIAN[1], IAN J. WALLACE[1], NICK HOLOWKA[1] and MICHAEL GURVEN[2]

[1]Department of Human Evolutionary Biology, Harvard University, [2]Department of Anthropology, University of California Santa Barbara

Convergent evolution of the human pygmy phenotype in tropical rainforests likely reflects adaptation, yet evidence for this phenotype's selective benefits remains lacking. Here we propose and test a model of how a rainforest environment can alter gait kinematics such that short stature becomes energetically advantageous. Specifically, we hypothesize that constraints on step length imposed by dense vegetation result in a stature-dependent tradeoff between walking speed and economy. According to this model, in a dense habitat taller individuals are expected to walk more slowly or less economically due to their inability to achieve preferred step lengths. We tested predictions from this model with experimental field data from two relatively short-statured populations that regularly forage in the rainforest: the Batek of Peninsular Malaysia, and the Tsimane of the Bolivian Amazon. First, we tested the prediction that step length is constrained in a rainforest environment. Second, we tested the prediction that shorter stature promotes walking at relatively higher preferred velocities in rainforests. Both predictions were supported, providing the first empirical evidence for the human pygmy phenotype as a locomotor adaptation. This model also has taxonomic relevance beyond humans, as directional selection for short stature should occur whenever environmental constraints cause biologically significant reductions in locomotor capacity in the context of a species' ranging and foraging ecology. This study highlights the value of applying laboratory-derived biomechanical models in field settings to test evolutionary hypotheses.

Examining Status in Medieval Italy: Using Skeletal Indicators to Identify Socioeconomic Status in Mortuary Samples

GIUSEPPE VERCELLOTTI[1,2] and MARISSA C. STEWART[3,4]

[1]Department of Anthropology, The Ohio State University, [2]Division of Health Sciences, The Ohio State University, [3]Teaching & Learning Transformation Center, University of Maryland, [4]Department of Anthropology, University of Maryland

Bioarchaeological research has relied on both skeletal and archaeological indicators to approximate socioeconomic status in the past. Analyses of cemeteries around medieval Europe, including in Italy, have shown that when socioeconomic status can be assigned based on archeological data, it is possible to detect skeletal differences between status groups in terms of osteometric, isotopic, and paleopathological variables. It is unclear whether patterns in skeletal indicator variation may be useful in detecting socioeconomic stratification in cemeteries that lack a clear spatial distinction between status group burials. Although no variation in burial types is present, the parish cemetery of *Pieve di Pava* (8th c.-12th c. Siena, Italy) is deemed to be representative of the entire medieval population inhabiting the area, including members of different socioeconomic status (N=125). This study aimed at identifying socioeconomic variation in this skeletal sample by performing correlation analyses on osteometric, isotopic, paleopathological, and spatial variables. Pearson's correlation coefficients (p-values, r-values) were used to identify the significance and nature of the correlations and highlight interesting patterns in this skeletal sample. Correlations were found linking paleopathological variables occurring at different ages (e.g., cranial porosities and degenerative joint changes) and with different etiologies (e.g., degenerative joint changes and dental health indicators). The results of the analyses and their significance are discussed, particularly as they relate to the identification of socioeconomic status from skeletal samples in the past.

The past, present and future of research on primate biomechanics in Belgium

EVIE E. VEREECKE[1], PETER AERTS[2], KRISTIAAN D'AOUT[3] and JEROEN STEVENS[4]

[1]Biomedical Sciences Group, University of Leuven, [2]Department of Biology, University of Antwerp, [3]Department of Musculoskeletal Biology, University of Liverpool, [4]Centre for Research and Conservation, Royal Zoological Society of Antwerp

In the last 20 years, Belgian researchers, together with international collaborators, have contributed significantly to a better understanding of primate locomotion. Major studies include the biomechanical analysis of locomotion in bushbabies (*Galago senegalensis*), bonobos (*Pan paniscus*), siamangs (*Symphalangus syndactylus*) and gibbons (*Hylobates lar*). In these studies, we have tried to encompass the entire locomotor repertoire of the animals, including bipedalism and quadrupedalism (bonobos, gibbons), jumping (bushbabies, bonobos, gibbons), vertical climbing (bonobos) and brachiation (siamangs). Importantly, a full quantification of the spatio-temporal gait parameters and gait dynamics was achieved using an integrated experimental set-up that was installed in the enclosure of the animals in the Wild Animal Park Planckendael (Belgium). A good collaboration with the zoo staff was imperative for the successful execution of these projects. Gradually, we also evolved from the use of instrumented walkways to instrumented poles with adjustable compliance to better mimic natural substrates and to include substrate interaction in the analyses. As biomechanical analysis of primate locomotion in the wild is still restricted due to technical and practical limitations, especially for arboreal animals, we believe that integrative modelling work, which combines biomechanical analyses and anatomical data in a virtual environment, is the next step to further increase our understanding of primate locomotion.

Important assets of these series of studies are (1) the use of a biomechanical approach to study primate locomotion; (2) studying untrained animals in semi-free-ranging conditions; (3) using state-of-the-art biomechanical equipment; and (4) mimicking natural substrates to include substrate interaction in the analyses.

The Research Foundation Flanders funded most of the studies, either as research projects or PhD fellowships.

Using ecomorphology of modern cercopithecoids for retrodiction of locomotor behavior of the fossil primate community of the Hadar and Ledi-Geraru sites, Afar Region, Ethiopia

MARIE VERGAMINI[1,2], IRENE E. SMAIL[3], KRISTI L. LEWTON[4,5], KAYE E. REED[3] and AMY L. RECTOR[2]

[1]Department of Biology, Virginia Commonwealth University, [2]Anthropology, School of World Studies, Virginia Commonwealth University, [3]School of

Human Evolution and Social Change, Arizona State University, [4]Department of Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California, [5]Human Evolutionary Biology Section, Department of Biological Sciences, University of Southern California

Isolated elements of fossil monkeys were retrieved from the Hadar and Ledi-Geraru sites. It is necessary to deduce fossil primate behaviors in order to reconstruct the paleoenvironmental parameters in which *Australopithecus afarensis* and early *Homo* evolved in the Afar. As a consequence of fossil fragmentation, methods of ecomorphological analysis of locomotor behaviors focusing on ulnae joint surfaces were applied.

East African sites are majorly represented by non-hominin primates, primarily monkeys. In recreating fossil monkeys' habitat use, this study applies 3D geometric morphometric analyses of the proximal ulnae of more than 70 extant cercopithecoids. We took into account locomotor habits, focusing on semi-terrestriality, to distinguish morphology based on locomotor behavior and substrate use. To measure modern variations and retrodict locomotor behaviors of more than 30 isolated fossil monkey elements from the Afar region, multivariate analyses were applied.

PCA, DFA, and PGLs results suggest that long bone joint morphology can successfully differentiate arboreal, semi-terrestrial, and terrestrial substrate use of modern cercopithecoids. Applying the variation in these elements can be used to characterize substrate use of fossil monkeys found in the Afar region. Through time, the fossil primate communities are reconstructed significantly terrestrial in Hadar and Ledi-Geraru. *Australopithecus afarensis* and early *Homo* co-existed and evolved within a community of primates approaching similar body size who also spent a significant part of their time moving, and likely foraging, on the ground.

Bioarchaeology of Care: The extended care of a debilitated hunter-gatherer with a possible case of Chagas Disease

KIRSTEN A. VEROSTICK[1] and KARL REINHARD[2]

[1]Department of Anthropology, University of South Florida, [2]School of Natural Resources, University of Nebraska-Lincoln

A naturally mummified individual, the Skiles Mummy (SMM), from the Lower Pecos Canyonlands of South Texas represents a unique case of care. SMM is an exceptional mummified individual within this region due to the retention of a full head of hair, and having a diagnosed case of megacolon. This condition is a complication commonly associated with Chagas disease (*Trypanosoma cruzi*). Stable isotopic analysis of the hair is consistent with a diet incorporating a mix of C_3 plants and C_4/CAM plants, freshwater resources, and higher trophic level animals. However, the four segments of hair most proximal to the scalp are outliers, with $\delta 15N$ $\bar{x}$ =13±0.13‰, whereas for the rest of the segments $\delta 15N$ $\bar{x}$ =12.4±0.2‰. This data from SMM indicates peristalsis likely ceased in the last four to five weeks of life, and since starvation causes $\delta 15N$ values to rise, the increase in $\delta 15N$ values for these hair segments is representative of malnutrition. Due to the lack of peristalsis in the digestive track and the presence of large fecal boluses, SMM would not have been able to adequately absorb protein and nutrients. This is evidenced in the coprolite studies of the boluses. Additionally, SMM's health condition would have rendered him immobile. Following Tilley's index of care, someone would have had to bring him food resources, as well as caring for his daily needs.

Adapting multivariate Brownian diffusion models to Bayesian inference of human population history and phylogeny

NIKOLAI G. VETR[1,2], MICHAEL R. MAY[2], BRIAN R. MOORE[2,3] and TIMOTHY D. WEAVER[1]

[1]Anthropology, University of California, Davis, [2]Center for Population Biology, University of California, Davis, [3]Evolution and Ecology, University of California, Davis

The field of statistical phylogenetics has progressed by leaps and bounds in recent years. Remarkable progress in developing models of molecular evolution stands in stark contrast to limited advances in the development of corresponding models of morphological evolution. Given the nature of data primarily available to paleontologists and paleoanthropologists — shapes and sizes of bones and teeth — the lack of morphological models has impeded statistical inference of phylogeny in these fields. Here, we first present a stochastic morphological model that describes the evolution of continuous traits using a multivariate Brownian diffusion process that leverages quantitative genetic theory to minimize the number of free (estimated) parameters. Unlike previous work, our model explicitly accommodates non-independence among continuous traits, which may more realistically reflect biological phenomena such as pleiotropy and developmental integration. We then explore the statistical behavior of this model through analysis of simulated data under conditions that closely approximate those of real data. Finally, we apply our method to two empirical datasets: Howells' (1973) craniometric measurements of modern humans, and to similar data collected on chimpanzees. Consensus trees obtained from each empirical analysis were consistent with accepted relationships in these groups. Several extensions of this model are also in development that will allow it to flexibly accommodate a wider range of data, such as discrete dental traits, and join it with molecular data to better shed light on evolutionary relationships linking fossil hominins.

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2000 year old case of β-thalassemia in Sardinia: implications for malaria history

CLAUDIA VIGANÓ[1], CORDULA HAAS[2], FRANK J. RÜHLI[1] and ABIGAIL S. BOUWMAN[1]

[1]Institute of Evolutionary Medicine, University of Zurich, [2]Institute of Forensic Medicine, University of Zurich

According to historical data malaria was introduced to Sardinia around 2600 years ago by the Punics and it only became endemic in the Middle Ages. However, many archaeologists have hypothesized that the infection was already present before the Punic arrival. Present day the island's history of endemic malaria is testified by the high incidence of β-thalassemia, and in particular by the cod39 mutation, which is responsible for almost all the β-thalassemia cases in Sardinia. To better understand the history and origin of β-thalassemia, and therefore malaria, on the island, 19 human tooth-remains from three different Punic and Roman necropolises (3rd century BC – 3rd century AD) of the island were investigated using PCR analysis. The cod39 β-thalassemia mutation was identified in one male individual buried around 2000 years ago. Mitochondrial and Y-chromosome haplogroup analyses revealed that this individual belonged to haplogroups U5a and I2a1a1 respectively, indicating that the individual was probably from European, possibly Sardinian, origins. The finding of such pathogenic mutation and its persistence until present days suggests that malaria was already endemic on the island by the Roman period, much earlier than suggested by historical records, giving more credibility to the hypothesis of an earlier introduction to the island.

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Paleogenomic study of Pre-Hispanic Civilizations in Central Mexico

VIRIDIANA VILLA-ISLAS[1], MARCELA SANDOVAL-VELASCO[2], ERICK RAMÍREZ CRUZ[1], MIRIAM J. BRAVO-LÓPEZ[1], ELIZABETH M. PÉREZ-CAMPOS[3], ALBERTO HERRERA MUÑOZ[3], EMILIA HUERTA-SÁNCHEZ[4] and MARIA C. ÁVILA-ARCOS[1]

[1]International Laboratory for Human Genome Research, National Autonomous University of Mexico, [2]Natural History Museum of Denmark, University of Copenhagen, [3]INAH-Querétaro, Instituto Nacional de Antropología e Historia, [4]School of Natural Sciences, University of California Merced

Toluquilla and Ranas are two neighboring archeological sites located at 2,460m over sea level in the Sierra Gorda, an ecological region in the State of Querétaro, Central Mexico. The length of their

occupation, from 400 BC through 1550 AD, is larger than other major Pre-Hispanic societies. This has been attributed to a steady economy based on mining of cinnabar—a toxic mineral from which mercury is obtained. Interestingly, these sites are located at the limits of the two large cultural regions of Aridoamerica and Mesoamerica. It has been hypothesized that the Toluquilla/Ranas area was occupied first by groups belonging to Mesoamerican-like civilizations, and subsequently by Chichimecas (nomad hunter-gatherers from Aridoamerica) as the perimeters of the regions allegedly shifted due to climatic fluctuations around 800 AD, causing a decline of some Mesoamerican civilizations. Despite this, Toluquilla and Ranas display striking cultural continuity, which opens the question of whether the populations that inhabited them were continuous, or if there were replacements as a consequence of the expansion of Aridoamerica into the south. To approach this we generated paleogenomic data from six individuals, four from Toluquilla and two from Ranas, from different time points spanning the time of the shift. We determined mitochondria and Y chromosome haplogroups, and used autosomal data to contrast past and present-day Native Mexican genetic diversity. Of notice, we identify that samples post-dating the shift have a clear genetic affinity to present-day populations from Central-West Mexico, while one sample that pre-dates it (1,200 YBP), falls outside known present-day genetic variation.

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Size and the morphology of the C2 (axis) vertebra in primates

CATALINA I. VILLAMIL

Anthropology, Dickinson College

The cervical vertebrae serve an important function supporting the head. As a result, the functional morphology of the cervical vertebrae is of particular interest as it relates to locomotion, posture, and the changes associated with bipedalism. This question is especially intriguing as early hominin fossils have cervical vertebrae that display primitive morphology, in particular in the C2 (axis) vertebra. The C2 serves a special function in that it allows rotation of the head, and while modern humans have a unique C2 with a vertical dens, early hominins display *Pan*-like morphology with a more horizontally-oriented dens. However, few studies have investigated the functional morphology of this vertebra. I collected 39 3D landmarks on the C2 vertebra from 146 anthropoid primates representing a variety of locomotor behaviors. I then used geometric morphometrics, regression, and CVA to test the relationship of C2 shape to locomotion, posture, and body size. My results show that the primary driver of C2 differences across taxa is size (R2=0.685, p<0.001). Larger taxa have a relatively longer spinous process and a more horizontally-oriented dens while smaller taxa have a relatively shorter spinous process and more vertically-oriented dens. Humans are particularly unusual then in being large and having a short spinous process and vertical dens. Due to the relationships between the head and neck, it seems likely that aspects of craniofacial morphology and the orientation of the head specifically (rather than posture generally) are driving C2 morphology. There is also a significant phylogenetic component (p<0.001) to C2 shape.

The Pliocene Savanna: integrating global climate models and regional stable isotope data from soils with implications for hominin ecology

AMELIA VILLASEÑOR

Biology, University of New Mexico

The origin of African savanna ecosystems has important implications in understanding the ecological pressures on early hominin evolution and ecology. It is predicted that middle-Pliocene Africa, home to up to five hominin species, was wetter overall and possibly cooler, with perpetual El Niño conditions, which could have maintained higher levels of woody cover throughout the middle Pliocene Africa as compared to the more arid conditions of today. To test this hypothesis, stable carbon isotope data from pedogenic carbonates are converted to a fraction of woody cover values and examined across rift valley sites in middle Pliocene Ethiopia and Kenya (3.6-3.0 Ma) (n= 191). These data are compared to a modern baseline of woody cover from satellite data from Ethiopia, Kenya, and Uganda. Results demonstrate that, in modern rift valley environments, it is not possible to achieve a potential woody cover values greater than 40% until a site attains at least 1000mm of rainfall per year, wherein pedogenic carbonates would not form. In contrast, the Pliocene Turkana Basin rift valley sites in this study maintain higher woody cover through time and space at lower levels of rainfall (<1000mm). For example, the four sites in the Turkana Basin, Kenya average 38% woody cover, while modern Kenyan sites average 17% woody cover. These results demonstrate Pliocene rift valley savannas may have been more heavily forested than extant rift valley ecosystems, which may suggest higher productivity and support the hypothesis that there were perpetual El Niño conditions.

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The Weakest Link: Performance and Fusion of the Primate Mandibular Symphysis

CHRISTOPHER J. VINYARD[1] and MATTHEW J. RAVOSA[2]

[1]Anatomy & Neurobiology, NEOMED, [2]Biological Sciences, Aerospace and Mechanical Engineering, and Anthropology, University of Notre Dame

Studies of musculoskeletal biomechanics routinely assume that morphological variation tracks differences in performance. Even when well supported by comparative and/or in-vivo evidence, such analyses typically lack essential data regarding the performance of the feature(s) of interest. In the skull, while the functional and phylogenetic significance of a fused mandibular symphysis is seemingly well documented in primates, there are no data regarding whether a fused joint is stronger than an unfused one. This shortcoming limits our understanding of patterns of phenotypic variation in the feeding apparatus and thus adaptive transformations during the origin of major clades such as Anthropoidea.

To address debate regarding determinants of symphyseal form and fusion, we collected ex-vivo data on the performance of the primate mandibular symphysis during simulated masticatory loading regimes. Roughly equal numbers of fixed adult mandibles were loaded to structural failure during simulated 'wishboning' and dorsoventral shear in 14 anthropoid and 20 strepsirrhine species. Results indicate that the fused symphysis in anthropoids requires significantly more force to induce structural failure in wishboning *and* DV shear than in strepsirrhines with unfused joints. As peak forces are generally higher during wishboning than DV shear, this suggests that the former loading regime is a significant determinant of symphyseal fusion in primates. Symphyseal fracture occurs at the midline in strepsirrhines with unfused joints, which demonstrates that ossification serves to strengthen the joint vs. ligaments and cartilage. In anthropoids with fusion, the degree of symphyseal curvature plays a role in determining the location of joint failure during wishboning.

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Local or migrant? Insight into culture complexity using stable oxygen isotopes at Himera

CHRYSANTHI VIOLARIS[1], LAURIE J. REITSEMA[2], KATHERINE L. REINBERGER[2], BRITNEY KYLE[3], PIER FRANCESCO FABBRI[4] and STEANO VASALLO[5]

[1]Department of Sociology and Anthropology, George Mason University, [2]Department of Anthropology, University of Georgia, [3]Department of Anthropology, University of Northern Colorado, [4]Department of Cultural Heritage, Università del Salento, [5]Archaeological Heritage Section, Superintendency of Palermo

Parting from ideas about colonization derived from recent, western colonialism, Greek colonization is better defined by "*apoikism*", an idea meaning "home away from home". Greek colonization occurred as people and ideas spread across the Mediterranean, creating hybrid cultures. Himera, a Greek colony in Sicily occupied from 7th-5th c. BCE, contains cemeteries with varied burial styles, allowing for mortuary studies ofcultural heterogeneity and hybridity. We use stable oxygen isotope analysis of human tooth enamel from individuals buried in terracotta tile (*cappuccina*) graves (n=62) to examine in-migration and population mobility at Himera, comparing locals and non-locals among a civilian population and a previously studied soldier population (n=62) buried in mass graves from the colony's two battles (480 and 409 BCE). Using the Global Network of Isotopes in Precipitation database, expected $d^{18}O$ values are calculated for areas of the Mediterranean to gauge possible points-of-origin. 83% of individuals in *cappuccina* graves are associated with local isotope ratios. Kruskal-Wallis and Chi-square tests revealed a significant difference between numbers of non-locals in *cappuccina* and solider burials ($p<0.05$).Chi-square tests comparingprevalence of non-locals at Himera's population versus other urban sites in Europe yielded varied results. These results suggest there was not a constant high flow of migration to the Greek colony of Himera; yet the inhabitants strongly identified with Greek culture, as seen through the mortuary record. Using stable oxygen isotope ratios to analyze Greek colonization and migration suggests that ideas, more than people, may have caused the persistence and spread of Greek culture.

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Primates and the Early Miocene mammalian arboreal guild of Patagonia

SERGIO F. VIZCAÍNO, NÉSTOR TOLEDO, SUSANA BARGO and NAHUEL A. MUÑOZ

División Paleontología Vertebrados, Museo de La Plata

During the Early Miocene, a time interval that includes the initiation of the Mid-Miocene Climatic Optimum, platyrrhines lived at 51°S in Argentine Patagonia, well beyond their most southern modern distribution. *Homunculus patagonicus*, the best known taxon, is represented by crania, mandibles, teeth, and a several postcranial elements, allowing the reconstruction of its position within the mammalian arboreal guild. We employed a broad array of data and methods to analyze three main biological traits - body size, diet, and substrate use- for all the arboreal mammals of a geographically and temporally restricted paleofauna (dated at 17.5-17.4 Ma), which is among the late Early Miocene paleocommunities known from the coastal Atlantic localities of the Santa Cruz Formation. *Homunculus patagonicus* has been estimated as an approximately 2.7 kg, above-branch quadruped that fed on mixtures of fruits and leaves. It shared the herbivorous arboreal guild with some seven genera of sloths (leaf eaters, between 30-100 kg) and two of rodents (one a fruit and leaf eater of ~0.65 kg; and the other a leaf eater of ~10-15 kg); none of them similar in size to *H. patagonicus*. Body size must have constrained branch size use, reducing competition among herbivores. Daily activity patterns (i.e., diurnal vs. nocturnal habits) may have been additional factors influencing putative niche partition. However, although *H. patagonicus* has been proposed as probably diurnal, such patterns cannot yet be assessed for most taxa. The scansorial borhyaenid metathere *Acrocyon sectorius* (~11.5 kg) may have been its main predator.

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Milk and Honey: Isotopic Reconstruction of Infant Weaning in Medieval Transylvania

MADDELINE R. VOAS[1], KRISTINA KILLGROVE[1], JONATHAN D. BETHARD[2], ROBERT H. TYKOT[2], ANDRE GONCIAR[3] and ZSOLT NYÁRÁDI[4]

[1]Anthropology, University of West Florida, [2]Anthropology, University of South Florida, [3]Archaeology, Archaeotek, [4]Archaeology, Haáz Rezső Múzeum

The biological milestones of childhood and infancy are often underrepresented in bioarchaeological discourse. This study answers questions about the period of breastfeeding and weaning in Medieval and early Modern Transylvania. Medieval literature in Europe recommended total weaning to occur by the age of three with supplementation of cereal grains or flours sweetened with animal's milk and/or honey. Using nitrogen stable isotope analysis of dentine from both deciduous and permanent teeth, the present study explored the diet of 16 non-adult individuals from the Reformed Church cemetery in Bögöz, Székelyland, Transylvania, dating between the 12th to 19th centuries AD.

The $\delta^{15}N$ values obtained from infants (13‰ average) were found to be statistically higher ($U=4.50$, $p=0.001$) than the average $\delta^{15}N$ values of the adult females (10.7‰). This difference is to be expected when infants are consuming breast milk. Additionally, an average trophic decline indicative of the weaning process is observable when investigating average $\delta^{15}N$ values of teeth that form at different ages, with a steady decrease seen in the nitrogen values over time. Deciduous incisors have the highest average $\delta^{15}N$ at 14.5‰, and the permanent first molars represent the lowest at 11.7‰. The results of this analysis support Medieval literature in Europe, where the cessation of weaning was recommended to occur by age three. Results show that these non-adults were obtaining breast milk, to some degree, up to this point. This research serves as the first study of infant weaning in Medieval Székelyland.

Dietary consequences of sexual size dimorphism in primate

ERIN R. VOGEL[1,2] and JESSICA M. ROTHMAN[3,4]

[1]Department of Anthropology, Rutgers, The State University of New Jersey, [2]Center for Human Evolutionary Studies, Rutgers, The State University of New Jersey, [3]Department of Anthropology, Hunter College of the City University of New York, [4]New York Consortium in Evolutionary Primatology, New York, NY

In dimorphic primates, sex differences in body mass have implications for meeting nutritional needs. Males are typically larger and thus require more nutrients than females on an absolute basis, assuming equivalent activity budgets; however, pregnant and lactating females have greater nutritional needs per kg of metabolic body mass than males. Thus, in group living primates, males and females may utilize different feeding strategies. To accommodate larger body mass, males may increase feeding time, increase feeding rate, spend less time processing foods, and/or eat higher quality foods compared to females. We use data from our own studies and reviewed the literature (n= 30) to examine how dietary strategies vary to meet their sex-specific nutritional needs. Preliminary results suggest that males use diverse strategies to accommodate larger body size. For example, silverback gorillas (*Gorilla beringei*) consume more food mass (g/day) than females, while male baboons (*Papio spp.*) eat higher quality foods. Other studies found no difference in feeding strategies between males and females or that females fed on higher quality resources. In cases where males are only slightly larger than females, the increased nutritional needs of females during pregnancy and lactation may offset the requirements of larger males, such that diets of males and females converge. Because feeding time, a variable more commonly collected in primate studies, is not a strong predictor of nutrient intake, more studies focusing on sex differences in nutrient intake are necessary to critically evaluate the energetic costs of sexual dimorphism across primates.

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Washington's Non-Forensic Human Skeletal Remains Law and the State Physical Anthropologist: A Model for Other States?

JULIETTE VOGEL and GUY L. TASA

Department of Archaeology and Historic Preservation, Washington State Historic Preservation Office

Legislation passed by the State of Washington modified several existing human remains laws to resolve conflicting regulations governing the handling of Native American and Non-Indian skeletal remains. The new law outlined a unified process for the reporting and handling of skeletal remains that mandated notifications to affected tribes and tribal participation in the disposition of Native American remains. The position of the State Physical Anthropologist was created (the first such position in the Nation) and gave jurisdiction over non-forensic human skeletal remains to the Washington State Historic Preservation Office. The State Physical Anthropologist is responsible for the investigation, the determination of origin and ancestry, and the reburial or repatriation of remains to the appropriate parties.

The implementation of this law over the past 10 years has resulted in the investigation of over 500 human skeletal remains cases, 80% of which were identified as Native American ("Indian" under state law terminology), the rest being comprised of pioneer remains and clinical specimens. Standardized inventories and data recordation, along with photographic documentation, are implemented in all cases and add to the growing body of osteological data for the indigenous peoples of the Pacific Northwest.

A review of this new law's implications for the public, archaeologists, and physical anthropologists is presented. We argue that, in addition to potentially creating new employment opportunities for bioarchaeologists across the country and possibly elsewhere, the law most importantly leads to an improved relationship between scientists and Native tribes.

Population history of Kennewick Man in global craniometric context

NOREEN VON CRAMON-TAUBADEL[1] and MARK HUBBE[2,3]

[1]Buffalo Human Evolutionary Morphology Lab, Department of Anthropology, University at Buffalo, [2]Department of Anthropology, The Ohio State University, [3]Instituto de Investigaciones Arqueológicas y Museo, Universidad Católica del Norte

Despite the availability of ancient genomes, the mode and timing of the first settlement of the Americas is still subject to intense debate. While there are numerous early Paleoamerican skeletons available from Meso- and South America, the available North (paleo)american skeletal record is comparatively sparse. Therefore, the relatively complete skeleton of Kennewick Man dated to ~8,500 BP provides key data towards resolving these debates. On the basis of cranial morphology, Kennewick Man is distinct from modern Native American populations, instead more closely resembling Ainu, Polynesian or Australasian populations. Conversely, recent analyses of ancient DNA suggest a closer affinity between Kennewick and contemporary Native American populations. Recently, we employed a multiple-effects apportionment model that differentiates between the effects of historical among-population divergence and geographically-mediated gene flow to infer the population (phylogenetic) history of Paleoamericans from Lagoa Santa, Brazil based on 3D craniometric data. Here, we apply the same methodological approach to test for the most likely model of shared common ancestry between Kennewick Man and a comparative global craniometric dataset for 17 extant populations. The null hypothesis that Kennewick shared most recent common ancestry with contemporary Native Americans was rejected. Instead, our results suggest that history models that link Kennewick with arctic populations or to the ancestor of all contemporary Asian and New World populations were statistically more likely. Therefore, as was the case with South American Paleoamericans, the observed craniometric variation within the Americas cannot be explained solely on the basis of *in situ* evolutionary processes.

The micromorpholgy and U-series dating of calcretes: A new chronometer for open air hominin and archaeological sites

JESSICA VON DER MEDEN and ROBYN PICKERING

Department of Geological Sciences, University of Cape Town

Pedogenic carbonate, loosely termed calcrete, is a ubiquitous feature of open air hominin and archaeological sites in South Africa. These deposits are an incredible resource, both as chronometers and as palaeohydrological indicators but are, as yet, virtually untapped. We present new micromorphological and age data from calcretes examined in two archaeological sites in South Africa: the Early stone age site of Elandsfontein in the Western Cape and the Middle stone age site of Gamohana Hill in the Northern Cape. At Elandsfontein these calcretes outcrop as laterally discontinuous 'pedestals' scattered across the dune field and consist of concentric layers of hard, resistant micrite, and less-resistant layers of quartz-rich sand. Flow marks, desiccation cracks and fossilised spring eyes suggest palaeo-spring activity and a supply of fresh groundwater to the area. Micromorphological investigations using a petrographic microscope reveal filamentous and anastomosing structures, evidence for microbial-induced precipitation of carbonate. Alternating light and dark micrite couplets and sparite-filled microcracks are evidence of wet and dry cycles. U-series dating of these calcretes provides a suit of ages from ~250 ka to ~1 Ma. Calcretes are abundant in the arid Northern Cape with several different types preserved. What appear to be groundwater calcretes form lense-like terraces on the talus slope below the Gamohana rock shelter, sometimes preserving stone tools. U-Th dating places these terraces around 40 ka. Understanding the formation history of these calcretes through micromorphological analysis, together with more U-series dating, will make a huge contribution to understanding the archaeological record from these sites.

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A test of the energy conservation hypothesis in Verreaux's sifaka (*Propithecus verreauxi*)

RACHEL VOYT and REBECCA J. LEWIS

Anthropology, University of Texas at Austin

The energy conservation hypothesis proposes that female dominance over males in lemurs arose as a direct result of the high energetic demands on reproductive females caused by the particularly strong resource seasonality and climate unpredictability of Madagascar. Reproductively mature females are thus expected to win more conflicts 1) than reproductively immature females, 2) during energetically costly seasons (e.g., late lactation), 3) in feeding contexts, and 4) only during reproductive years. We analyzed the effects of female reproductive maturity, season, and status, as well as social context, on the expression of female dominance. Data on four social groups of Verreaux's sifaka (*Propithecus verreauxi*) were collected from 2007 to 2015 and included 830 decided agonistic interactions between 92 unique female-male dyads. Overall, female dominance was expressed unambiguously, with the majority of conflicts decided in favor of females throughout the year. Generalized linear mixed models showed that female reproductive maturity, but not context or season, had a significant influence on conflict decision. Furthermore, after reaching maturity, female reproductive status had no influence on intersexual conflict decisions. The energy conservation hypothesis was thus only partially supported. These findings call into question the assumption that female energetic needs are sufficient to require female dominance over males. Future studies documenting the physiological changes and energetics associated with reproductive maturity may aid in re-evaluating this key assumption.

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Using phylogenetic analyses to date the prehistory of the Afroasiatic language family

DEVEN N. VYAS[1,2], SHIFERAW ASSEFA[7], J. LAFAYETTE GASTON[3], TIFFANY GLEASON[4], CHRISTOPHER EHRET[5] and ANDREW KITCHEN[6]

[1]Department of Anthropology, University of Florida, Gainesville, [2]Genetics Institute, University of Florida, Gainesville, [3]Cotsen Institute of Archaeology, University of California, Los Angeles, [4]Department of History, Macalester College, St. Paul, Minnesota, [5]Department of History, University of California, Los Angeles, [6]Department of Anthropology, University of Iowa, Iowa City, [7]No affiliation

The Afroasiatic language family originated in Africa, and the locations of the two earliest divergences of the family, Cushitic and Omotic, in the areas surrounding the Horn of Africa identify these portions of the continent as the probable origin region of the family. This paper tackles the more complex issue of identifying, dating, and locating the successive divergences and expansions of Afroasiatic-speaking populations over the past 15-20,000 years. In this study, Bayesian phylogenetic methods developed to estimate biological evolutionary relationships and molecular genetic change between organisms were applied to the comparable linguistic processes of lexical change over time across the Afroasiatic family. Importantly, what makes it possible to calculate dates in the case of the Afroasiatic family is the availability of lexica of languages written down at known dates as much as 4,000 years in the past, as well as lexica of the modern-day, still-spoken languages of the family, both of which provide important information for calibrating the rate of lexical change. This project builds its findings on the processing of more than 16,000 individual data points from more than 180 languages. The materials presented in the project reveal a very long and complex prehistory of the family in Africa and constitute a major resource for future linguistic studies of human prehistory more widely. Furthermore, our results can be used in conjunction with genetic data from Afroasiatic-speaking populations to better understand their population histories and relationships to each other.

Three juvenile black-handed spider monkeys (*Ateles geoffroyi*) living with missing or atrophied limbs at El Zota Biological Field Station, Costa Rica

NICOLE WACKERLY[1], STACY LINDSHIELD[2], JILL D. PRUETZ[3] and MICHELLE RODRIGUES[4]

[1]Ecology and Evolutionary Biology Interdepartmental Program, Iowa State University, [2]Department of Anthropology, Purdue University, [3]Department of Anthropology, Texas State University, [4]Beckman Institute, University of Illinois

Information on severe disabilities in wild non-human primates is sparse. We present three accounts of juvenile spider monkeys (*Ateles geoffroyi*) with missing/atrophied limbs living in a lowland rainforest in northeastern Costa Rica: a juvenile female missing her left arm recorded in July 2006, a juvenile male (JF) missing his right arm first observed in July 2014, and a juvenile male with an atrophied right arm recorded in March 2016. Such individuals provide insight into the adjustments of non-human primates to physical limitations, and assist interpretations of the hominin fossil record, where evidence of severe injury or illness is interpreted as evidence for empathy, cooperation and caregiving. We examine possible explanations for the missing limbs observed at El Zota Biological Field Station including (1) birth deformity caused by inbreeding or mutation, (2) interspecies aggression, (3) intraspecies aggression, (4) disease, and (5) accident. Moreover, we describe positional behavior for JF. JF was compared to spider monkeys of the same age that had all functioning limbs to determine whether he exhibited differing postural and locomotor behaviors. Results indicate that JF adjusted well; he limited use of behaviors involving the forelimbs (e.g. tail-forelimb hang: 0.02% JF vs. 21.52% other juveniles), but otherwise employed a postural and locomotor repertoire similar to able-bodied members of the community (e.g. quadrupedal/tripedal walk: 21.69% JF vs. 21.35% other juveniles). JF accommodated his missing limb in a way that improved his efficiency during daily activities, suggesting that disabled individuals can effectively adjust to impairments.

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New observations of meat eating and sharing in wild bonobos (*Pan paniscus*) at Iyema, Lomako Forest Reserve, DRC

MONICA L. WAKEFIELD[1], ALEXANA J. HICKMOTT[2], IAN Y. TAKAOKA[1], COLIN M. BRAND[2], MICHEL T. WALLER[2,3] and FRANCES J. WHITE[2]

[1]Sociology, Anthropology, & Philosophy, Northern Kentucky University, [2]Anthropology, University of Oregon, [3]Anthropology, Central Oregon Community College

Bonobos (*Pan paniscus*) are known to hunt and consume a variety of mammals, however, direct observations of meat consumption and meat sharing by bonobos are still rare. What observations are available suggest that prey choice and rates of consumption vary between populations. Here, we report on the first direct observations of meat eating and sharing among semi-habituated bonobos at Iyema, Lomako Forest, DRC. We observed bonobos at Iyema over 160 hours for five months from May through October 2017. We observed bonobos consume duiker meat on three occasions, found a duiker carcass post consumption for a fourth event, and observed duiker hair in one bonobo fecal sample. We identified the prey species as Weyns's duiker (*Cephalophus weynsi*) for the three observed events and the discovered carcass. Meat sharing occurred during all three direct observations. However, the individual controlling the carcass (adult females for two events and an adult male for one) frequently resisted, sometimes aggressively. These data indicate that bonobos at Iyema consume meat at a much higher rate (0.8 times/month) than previously reported for other bonobo populations. Additionally, bonobos at Iyema may be targeting a specific prey species. Despite the presence of duikers, bonobos at Wamba only consume anomalures whereas bonobos at nearby Iyondji primarily consume duikers; at LuiKotale bonobos consume duikers, galago, and monkeys. These differences may represent cultural variation in prey choice among bonobos. This report contributes to our limited, yet growing understanding of meat consumption and sharing among wild bonobos.

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Deviance, pregnancy, and violence: an in-situ maternal-perinate burial from Late Prehistoric Pennsylvania

ROBYN WAKEFIELD-MURPHY

Anatomy, New York Chiropractic College

A young female (FC#442) from the Shippenport site in Pennsylvania (1250-1580AD) with in-situ remains of a 24 week fetus was analyzed as part of a wider examination of gender, health, and mortuary patterns among the Late Prehistoric Monongahela tradition (Wakefield-Murphy 2017). Located under a tree outside the confines of the adjacent village, the burial contained large number of bone and shell beads with embedded projectile in the posterior shaft of the 12th rib (Mayer-Oaks et al. 1952). Multivariate cluster analyses revealed this burial to be a statistical outlier in multiple respects: grave location, number/class of grave goods, and trauma. Other adults from this time period were buried in the flexed position within the village palisades with few grave goods; FC#442 represents the only incidence of projectile trauma in the analysis (n=330). Few cases of in-situ fetal maternal burials have been cited in bioarchaeological literature (Willis and Oxenham 2011). Pregnancy and childbirth are processes through which a new individual is brought into a society, the physical body is altered, and the cultural role of the mother may shift. In the case of FC#442, this burial is not representative of childbirth death, but rather violent injury or accident by arrow wound. It is argued that an unexpected and unnatural cause of death of a pregnant woman would have been seen as a rare event in which greater societal grief was invested (Sayer and Dickinson 2013), and it

is thus argued that this case represents female fertility associated space in death (Wakefield-Murphy 2017).

Accuracy of human-based morphometric equations for predicting bonobo body mass

CHRISTOPHER S. WALKER[1,2,3], GABRIEL S. YAPUNCICH[1,2], ALEAH BOWIE[2], RAPHAËL BELAIS[4] and STEVEN E. CHURCHILL[2,3]

[1]Molecular Biomedical Sciences, North Carolina State University, [2]Evolutionary Anthropology, Duke University, [3]Evolutionary Studies Institute, University of the Witwatersrand, [4]Lola ya Bonobo

An accurate estimate of body mass is integral to reconstruct the biomechanics, physiology, and ecology of extinct hominins. Given potential differences in hip biomechanics between hominin taxa, morphometric body mass prediction equations, based on stature and bi-iliac breadth, are arguably preferable to mechanical prediction equations, which typically rely on load-bearing joint dimensions. Recent work has demonstrated that morphometric equations based on adult humans produce reasonably accurate predictions of juvenile human body mass, suggesting these equations may be applied to small-bodied hominins with some confidence. However, while human juveniles overlap in size with a number of hominin taxa, their limb and body proportions often differ. Bonobos, which also possess limb and body proportions unlike humans, overlap in size with many smaller hominins and are an ideal sample to test the robusticity and generality of human-based morphometric equations. Here we evaluate the accuracy of two human-based morphometric prediction equations derived from human reference samples – one novel juvenile equation and a previously published adult equation deemed most accurate in previous work – for predicting the mass of 56 semi-free-ranging bonobos from Lola ya Bonobo. The adult human equation systematically underpredicts bonobo body mass, with a median prediction error (PE) of 26%. In contrast, the juvenile human equation has a significantly lower median PE (10%) and predicts the majority of test specimens within ±20% of their observed body mass. These results suggest that the juvenile morphometric prediction equation may be preferable to adult-based equations for predicting body mass in small-bodied hominins.

Inbreeding risk and female kin support predict settlement decisions in female chimpanzees in Gombe National Park

KARA K. WALKER and ANNE E. PUSEY

Evolutionary Anthropology, Duke University

Chimpanzees are unusual among primates in that males are philopatric and most females disperse around sexual maturity. Historically, the Kasekela community in Gombe National Park, Tanzania appeared unique in that roughly 50% of females remained in their natal community to breed. However, accumulating evidence from other sites suggests that female dispersal is not as ubiquitous as once thought and certain conditions may promote female philopatry. In particular, female kin support and access to unrelated mates may outweigh the risk of breeding with close male relatives. Here, we examine the influence of inbreeding risk, female kin support, mate choice, female competition and habitat quality on dispersal decisions in thirty one females maturing in the Kasekela and Mitumba communities of Gombe National Park. Model selection revealed that females were more likely to disperse if they had more male maternal relatives and were less likely to disperse if they had strong female kin support in their natal community. Additionally, there was weak support suggesting poor habitat quality promotes dispersal while there was no evidence that female competition or access to unrelated mates in the natal community affected dispersal decisions. These results suggest that escaping the risk of inbreeding is important, but benefits gained from female kin support, which likely include access to familiar foraging areas and coalitionary support in female interactions, can tilt the equation in favor of philopatry.

Data collection: Jane Goodall Institute, long-term database: NSF (DBS-9021946, SBR-9319909, BCS-0452315, IIS-0431141, IOS-LTREB-1052693), Walker: Margot Marsh & Leakey Foundation.

Where Is remodeling most active across skeletal elements and taxa?

ROBERT A. WALKER

Anatomy, New York Chiropractic College

Over the last half century, tremendous progress has been made in understanding skeletal remodeling at both the macroscopic and microscopic levels. Traditionally, efforts focus on femur, particularly regarding bone histology as an estimator of age. The femur presents a very thick, wide cortex that survives well in archaeological and forensic contexts. In our laboratory we have investigated variation in haversian remodeling proximodistally in all the major long bones in different vertebrate taxa. Results from locations sampled along the lengths of the long bones, and from various locations around the shafts of the bone demonstrate large scale variation in different locations. Across three species (H. Sapiens, Felis silvestris catus, Gallus gallus), highest densities of haversian systems are found proximally and midshaft. This holds in the major long bones: humerus, radius, ulna, femur, tibia. No single location in the skeleton can indicate overall skeletal homeostasis, or from which a low-error estimate of age may be consistently made. Across species, interbone variation in remodeling is tremendous. Variation around the cortex of a single bone within the skeleton may exceed that between bones in the same limb, or between limbs. Among older humans (> 50 years), some areas of the cortex of long bones may demonstrate high correlations with age in one location, with significant negative correlation in other areas. Generalizing from a few skeletal locations can lead to errors. We suggest that these patterns are less a reflection of Wolff's law, but also reflect underlying intrinsic developmental parameters specific to each bone.

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Action-oriented conservation projects as an instrument for enhancing student engagement and addressing conservation issues

SUZANNE E. WALKER-PACHECO[1], JOSHUA M. LINDER[2] and JULIE A. SHERMAN[3]

[1]Sociology and Anthropology, Missouri State University, [2]Sociology and Anthropology, James Madison University, [3]Director, Wildlife Impact

Given the increasing levels of endangerment of wild primates together with high levels of interest in primate studies, undergraduate courses in primatology and primate conservation provide an ideal opportunity for development of action-oriented student conservation projects. Such experiential learning bridges the gap between theory and practice, enhances learning and content retention, and develops problem-solving and critical thinking skills.

Preliminary data indicate that student participation in class-assigned conservation engagement projects in Missouri State University and James Madison University primatology classes have enhanced students' educational experience as evidenced by course evaluations, relevant student-initiated extracurricular activities, student response, and project outcomes. We present examples of these projects and discuss changes observed among students who conducted them. Such changes include: increased commitment to Anthropology Club and initiatives involving conservation activities, increased primatology student conference presentations, and self-reported changes in environmentally-related behaviors. The Network of Conservation Educators and Practitioners demonstrate that such engagement activities can both develop key skills important for primate conservation work, and enhances awareness of conservation issues among the general public.

We propose a nationwide collaboration among professors teaching primatology and primate conservation courses, in which effective action-oriented conservation projects are shared and centralized on a searchable website. We provide a model for projects with accompanying outcomes-based assessments and the

preliminary structure of a website "clearinghouse" where primatologists and conservationists can share issues and projects tied to student engagement activities.

This active learning approach not only contributes to student success, but also provides a potentially powerful tool for addressing current conservation issues.

The power stroke and the power curve

CHRISTINE E. WALL

Evolutionary Anthropology, Duke University

Muscle force, power, and efficiency are a function of contractile velocity. Locomotor muscles typically shorten at velocities (V) that maximize power (=work/time, which peaks at V/Vo=0.15-0.40 where Vo=maximal shortening velocity). If the power stroke of mastication is a near-static event, then isometric force, not power, is a key component of food breakdown. I analyze EMGs, musculoskeletal architecture, fiber type (MyHC), and kinematic data for *Papio anubis* during popcorn kernel mastication to evaluate whether sufficient shortening velocity occurs to optimize muscle power. A bracketed model estimates the range of V/Vo for superficial and deep anterior temporalis and superficial masseter (SAT, DAT, SM) following Rome et al. Power stroke speed at the canines is not negligible (~16-27mm/s). All muscles have high fiber length variation. SAT is >95% MyHC-2M, whereas DAT and SM express both MyHC-2M and MyHC-1. SAT V/Vo is bi-modal. Long fibers have low values (V/Vo=.04-.09) close to, but not at, the isometric force maximum (V/Vo=0). Short fibers cluster within the peak region of the power curve (V/Vo=0.15-0.42). DAT and SM share similar V/Vo ranges also clustering in the peak region of the power curve. The results suggest that muscle recruitment pattern, fiber type, and fiber length are integrated to provide jaw-adductors a wide range of flexibility in force, power, and efficiency. As in locomotor muscles, the jaw-adductors contract at velocities during the power stroke that often maximize muscle power rather than isometric force. The power stroke is a dynamic event.

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Foot sole cushioning lowers the magnitude and rate of tibial shaft strains recorded *in vivo* during running

IAN J. WALLACE, MICHAEL RUIZ, NICHOLAS B. HOLOWKA and DANIEL E. LIEBERMAN

Human Evolutionary Biology, Harvard University

Physical activities such as running that generate high magnitudes and rates of tissue-level strain in the weightbearing skeleton have the potential to be potent stimuli for bone formation. Thick, cushioned soles of modern athletic shoes, however, may decrease levels and rates of skeletal strain and consequently diminish the osteogenic response to running. In this pilot study, we explore the effects of foot sole cushioning on running-induced skeletal strains using an animal model (Hartley guinea pig). A single-element strain gauge was surgically implanted axially on the anteromedial surface of the animal's tibial shaft. Strains were recorded *in vivo* while the animal ran (30 m/min) on a treadmill both with and without foam cushioning attached to the belt (n=20 gait cycles/condition). The cushioning material (8-mm thickness) was similar in composition and stiffness to materials commonly used for athletic shoe soles. During the stance phase of running, tibial strains were predominantly compressive and maximum near midstance. Strain magnitudes (peak-to-peak) generated on the cushioned and uncushioned treadmill belts ranged, respectively, from 299 to 384 με and 295 to 437 με. Strain rates engendered on the cushioned and uncushioned treadmill belts ranged from 2986 to 4237 με/sec and 3181 to 5667 με/sec, respectively. If these preliminary data can be extrapolated to humans, then our results suggest on the basis of the lower maximum strain levels and rates associated with foot sole cushioning that running in highly cushioned athletic shoes may be a weaker stimulus for bone formation than running in shoes with minimal cushioning.

Are there any sexually dimorphic measures that matter for locomotor effort?

CARA M. WALL-SCHEFFLER[1,2] and MARCIE J. MYERS[3]

[1]Biology, Seattle Pacific University, [2]Anthropology, University of Washington, [3]Biology, St Catherine University

Energetic economy refers to the absolute amount of energy spent on a particular task. Energetic efficiency is the relative amount of energy spent given the amount of work performed. Humans have numerous sexually dimorphic characters that have the potential to influence locomotor economy and efficiency, including the absolute size and shape of the limbs, and their relative proportions to the rest of the body. In addition to these bony characters, physiological characters such as muscle quantity, size and type, and thermoregulatory mechanisms also influence efficiency and economy, and can vary along a continuum between sexes. On average, men have increased muscle mass in the upper body, absolutely longer lower limbs and broader shoulders, relatively narrow pelves, absolutely more water, and an increased reliance of sweating. Women are absolutely smaller than men, and have relatively more muscle mass in the lower body, relatively broader pelves, and an increased reliance on blood perfusion as a thermoregulatory strategy. Here we will show data on human locomotion illustrating that men can perform high rate locomotion and are more likely to make behavioral changes in response to energetic consumption rather than heat load. Conversely, women show increased energetic efficiency during all load-bearing walking, increased locomotor economy at all gaits, and more strategies to decrease their thermal load.

Isotopes and Famine: An Isotopic Comparison of Famine and Attritional Burials in a Late Medieval London Cemetery

BRITTANY S. WALTER[1], SHARON N. DEWITTE[2], JULIA BEAUMONT[3] and TOSHA DUPRAS[4]

[1]Defense POW/MIA Accounting Agency, Department of Defense, [2]Department of Anthropology, University of South Carolina, [3]School of Archaeological and Forensic Sciences, University of Bradford, [4]Department of Anthropology, University of Central Florida

Late Medieval London (12^{th}–16^{th} centuries CE) experienced several instances of famine as a result of excessive rains that resulted in poor harvests across Europe. These periods of famine correlate with increased mortality in the archeological record demonstrated through catastrophic mass burials in Late Medieval London. As clinical, bioarchaeological, and forensic research have demonstrated that enriched nitrogen can indicate nutritional stress and starvation, stable isotope analysis of bone collagen, particularly $\delta^{15}N$ values, may be used to determine individual nutritional stress. This suggests that individuals interred during periods of famine, and thus likely facing nutritional stress, would exhibit elevated $\delta^{15}N$ values compared to individuals interred during non-famine periods. To evaluate whether individuals experiencing nutritional stress exhibit enriched nitrogen, $\delta^{15}N$ and $\delta^{13}C$ values from rib bone collagen of individuals interred in famine-related mass burials and attritional burials in St Mary Spital cemetery are compared using a pooled-sex sample (n = 166) and separately for each sex. Results indicate that individuals in attritional graves exhibit significantly elevated $\delta^{15}N$ values compared to individuals in famine graves; these results are also evident in females though the difference is not significant. Rather than reflecting differences in nutritional stress, these results may actually reflect differences in diet that could have been a consequence of famine. Individuals during non-famine periods may have been eating different proportions of foods, particularly more protein. Additionally, isotope values from the rib bone collagen may not reflect nutritional stress experienced just prior to death because of slow tissue turnover rates.

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Bison Hides and Biomechanics: Experimental Bioarchaeology of Wichita Scraper Technologies

MICHAEL C.H. WALTERS[1], LESLEY RANKIN-HILL[2] and CHRISTOPHER BLACK[3]

[1]NAGPRA Project, University of California: Davis, [2]Department of Anthropology, University of Oklahoma, [3]Department of Health and Exercise Science, University of Oklahoma

Recently, electromyography (EMG) has been incorporated in activity reconstruction studies to provide further explanation for paleopatholgies linked with certain tasks (e.g. spear thrusting, grinding grains). A pilot study was designed based on Wichita archaeological and ethnohistorical evidence for changes in bison hide processing by Wichita women to meet demands of the French Fur Trade. Pre-Contact scrapers were hafted and smaller; whereas, Post-Contact scrapers were handheld and larger. Hypothesizing that muscle activity increased using Post-Contact scrapers than when using Pre-Contact scrapers during hide processing, EMG measurements could provide a hypothesis model of potential locations of activity related paleopathologies. Female participants (n=10) reenacted the dehairing process using both scrapers and in two positions, kneeling and crouching. Electrodes were placed on the *biceps brachii*, *posterior deltoid*, and *brachioradialis*. Participants completed four trials with every combination of tool type and position. Quantitatively, Post-Contact scrapers produced higher muscle innervation than Pre-Contact scrapers. A 2x2 Repeated Measures ANOVA tested significance ($p \leq 0.05$) of muscle groups between scrapers and position. *Posterior deltoid,* had significance between position and tool type ($p < 0.003$; Bonferroni correction < 0.05). The *biceps brachii* had no significant interaction between scraper and position ($p < 0.53$); however, there was significance between positions ($p < 0.009$). The *brachioradialis* had no significant effect ($p < 0.058$). Future research includes a larger sample size, a time component, and pQCT to document potential changes in the musculo-skeletal system. Furthermore, EMG studies can reevaluate previous activity reconstruction interpretations and provide deeper insight to explain activity related paleopathologies.

A skull with a benign tumor from Iron Age Nileke Site, Xinjiang with special references to skeletal deformation and adaptation

QIAN WANG[1], QUN ZHANG[2], TAO HAN[2], HONG ZHU[2] and QUANCHAO ZHANG[2]

[1]Department of Biomedical Sciences, Texas A&M University College of Dentistry, [2]Department of Archaeology, Jilin University

Tumors are uncommon in the skull, and their consequences to the health of the general population is difficult to assess. In this study, we report a case of possible benign tumor arising in the temporal bone from a male skeleton excavated at the Iron Age Nileke Site, Xinjiang, China (Age at death 20-25 years). The lesion presented as a cluster of bony spikes (about 14mm in height, 28mm in diameter) in the infratemporal fossa, leading to remarkable morphological changes in the left skull. The infratemporal fossa at the left side was about two times the size of that at the right side, with the thinning and deformation of adjacent bones. In addition, the left coronoid process curved laterally to be nearly horizontal, and the left mastoid process and the articular surface of the left occipital condylar were larger than those at the right side. These signs indicated that this lesion was a long-term isolated space-occupied solid tumor with internal ossification. Though its exact diagnosis was unclear, there were no signs of cortical bone destruction or periosteal reaction, indicating the differential diagnosis with osteosarcoma, osteoblastoma, and other lesions. This focal mass might have started from early childhood and slowly grew laterally, inducing musculoskeletal deformation at the left side and long-term left tilting of the head. This rare case of calvarial bone-associated tumor not only enriches our knowledge of paleopathology in ancient people living in Northern China, but also demonstrates long-term skeletal adaptation to a slow growing tumor in the skull.

Postcranial functional anatomy of *Australopithecus (Paranthropus) boisei* and *A. (P.) robustus*

CAROL V. WARD[1] and MICHAEL R. LAGUE[2]

[1]Pathology & Anatomical Sciences, University of Missouri, [2]School of Natural Sciences & Mathematics, Stockton University

Although their craniodental remains are well represented in the fossil record, the postcranial morphology of *Australopithecus (Paranthropus) boisei* and *A. (P.) robustus* is poorly known. Few postcranial specimens in either eastern or southern Africa are associated with craniodental elements, confounding our ability to interpret the locomotor and/or manipulatory capabilities of these 'robust' australopith species, or compare their anatomy to one another. Even so, the few reliably attributable specimens, along with patterns of morphological variation within samples of isolated bones, provide at least some basis from which to make tentative functional interpretations. We review postcranial remains that are both firmly and tentatively attributed to *A. (P.) boisei* and *A. (P.) robustus*, and consider the functional implications of their morphology and how they compare with what is known from early *Homo* species. Both 'robust' australopith species appear similar to one another in having anteroposteriorly compressed femoral necks and small femoral heads like other australopiths and unlike *Homo*. 'Robust' australopiths and *Homo* appear to differ from one another in humeral morphology, however, and possibly in some aspects of talar form. The radius of *A. (P.) boisei* differs from that of early *Homo*, and, combined with information from the distal humerus and possibly also the ulna, suggests functional differences in the elbow and forearm from early *Homo*. These comparisons have implications for the taxonomic attribution of the partial skeleton KNM-ER 1500, and affect our understanding of hominin postcranial diversity, body size, and dimorphism in early *Homo* as well as within the 'robust' australopith species.

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Using Unintentional Vault Modification to Evaluate Integration of the Bony Labyrinth and Cranium

DEVIN L. WARD[1], KAREN L. BAAB[2], T. BENCE VIOLA[1] and MARY T. SILCOX[3]

[1]Department of Anthropology, University of Toronto, [2]Department of Anatomy, Midwestern University, [3]Department of Anthropology, University of Toronto Scarborough

Unintentional cranial vault modification, often due to cradleboarding, is known worldwide in the historic and archaeological record. The resulting positional plagiocephaly has been used to examine cranial integration, but studies have not considered internal cranial structures, such as the bony labyrinth. This project tests developmental stability and cranial integration of the bony labyrinth using geometric morphometrics and multivariate statistics. Although growth of the labyrinth is complete pre-natally, its position and orientation within the cranium may be affected by cranial deformation. Thus, we hypothesize that the position of the labyrinth will differ between normal and plagiocephalic crania.

To test this hypothesis, 51 midline and bilateral landmarks, including 18 landmarks on the right and left bony labyrinths, were collected from three archaeological samples: Averbuch site from the Middle Cumberland of Tennessee (n=12), and Tijeras (n=6) and Pottery Mound (n=9), both Pueblo IV groups from New Mexico. Each group includes individuals with symmetric and asymmetric modification, as well as unaffected individuals. After superimposing all landmarks, a PCA of complete crania separates individuals with right and left asymmetric modification from each other, with symmetrically modified and unaffected individuals falling in-between. A two-block PLS identified significant covariance ($p<0.001$, RV=0.83) between labyrinthine and cranial shape.

The bony labyrinth and petrous are thought to be a particularly stable region, but evidence here indicates that the position of the structures within the cranium is plastic after birth. Maintenance of hearing and equilibrium in the face of

developmental positional instability implies some neurological plasticity in the vestibulo-auditory system.

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The effect of trunk position on lower body mechanics during running

ANNA G. WARRENER[1], ROBERT TAMAI[2] and DANIEL E. LIEBERMAN[3]

[1]Anthropology, University of Colorado Denver, [2]No affiliation, [3]Human Evolutionary Biology, Harvard

Endurance running capabilities have likely been selected in the genus *Homo*, yet individuals show large variation in kinematics and kinetics. One aspect of running form that has been understudied is trunk posture. At roughly 50% of total body mass, small changes in trunk orientation may alter lower-limb kinetics and ground reaction forces generated to maintain stability during running. We hypothesize that greater forward trunk lean decreases step frequency and increases step length relative to the body center of mass (overstride) to maintain dynamic support. Greater overstride is compensated for by greater extensor moments about the hip and increased rates of loading and peak transient magnitudes of the vertical ground reaction force. Twenty-two individuals participated in running trials on an instrumented treadmill while kinematic data was collected. Trunk forward lean of 10, 20 and 30 degrees was induced by a horizontal rod suspended over the subject's head while running. Research was approved by the Committee on Use of Human Subjects at Harvard and subjects provided informed consent. Results show a strong positive correlation between trunk angle, overstride ($p < 0.01$) and hip extensor moments ($p < 0.01$), but trunk angle did not significantly affect stride rate. Peak transient magnitude was also positively correlated with trunk lean ($p < 0.01$) but rate of loading was not significantly different. These results suggest the strong influence of trunk posture on lower-limb mechanics during running and should be considered when assessing anatomical adaptations for running in modern humans and the occurrence of injury.

A molecular anthropological re-examination of the human remains from La Galgada, Peru

EDEN WASHBURN[1,2,3] and LARS FEHREN-SCHMITZ[1,2]

[1]Anthropology, UC Santa Cruz, [2]Paleogenomics Laboratory, UC Santa Cruz, [3]Molecular Dietary Ecology Laboratory, UC Santa Cruz

The site of La Galgada, on the eastern bank of the Tablachaca River in Peru, provides an interesting context in which to study the uneven spread of maize agriculture and its effects on population interaction. The site was occupied from approximately 3000BC to abandonment in 1500BC, with evidence of maize agricultural production within the Tablachaca Canyon appearing by 2000BC. There is however, limited archaeological evidence for the acquisition of maize agriculture at the site of La Galgada. Radiocarbon dating of human remains from 9 tombs, aDNA and isotopic data has illuminated a pattern of site use and potential changes in subsistence practices. While the majority of direct dates fall during site occupation, tomb E-11 J-7, originally dated to the Initial Period, contained burials dating to within the Late Intermediate Period (1290-1390AD). Stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$) of human remains (N = 30) from the 9 multi-burial tombs were analyzed. Even with limited evidence of maize agriculture, $\delta^{13}C$ values indicate that there is an approximately 6‰shift, from a C_3 plant diet to a C_4 diet between some Late Archaic and Initial Period burials. E-11 J-7 burials follow the Late Archaic pattern with $\delta^{13}C$ values falling within a C_3 plant range (average -19‰). $\delta^{15}N$ values remain relatively consistent across these time periods, with values averaging 7.5‰, indicating low levels of terrestrial protein. Additionally, aDNA analyses provide interesting insight into this transitional period. The obtained mitochondrial data suggest population discontinuity coincident with the spread of maize agriculture into the Tablachaca Canyon.

Primate ecotoxicology in Costa Rica: Assessing an overlooked threat to primates across a series of forest fragments

MICHAEL D. WASSERMAN[1], PETER BECK[2], TESSA STEINICHE[1], ERIC JOHNSON[2], RODOLFO QUIRÓS[3], KENNETH ALFARO GONZÁLEZ[3], ABIGAIL KROPF[2], SARAH MATTECHECK[2], TERESA JOHNSON[2], SHAORUI WANG[4], KEVIN ROMANAK[4] and MARTA VENIER[4]

[1]Anthropology, Indiana University, [2]Environmental Management & Sustainability, St. Edward's University, [3]Las Cruces & La Selva Biological Stations, Organization for Tropical Studies, [4]School of Public & Environmental Affairs, Indiana University

Primates in protected areas likely encounter synthetic toxins through exposure from agriculture, urbanization, and pest control, even in remote regions. The extent to which primates are exposed to synthetic toxins may have major effects on their ability to maintain sustainable populations as some toxins alter physiology and behavior important to reproduction and survival through direct interactions with the endocrine system. Therefore, we examined variation in potential exposure to polybrominated diphenyl ethers (PBDEs), current use pesticides (CUPs), legacy pesticides, and organophosphate esters (OPEs) across 23 passive air samplers distributed within 18 forests that included national parks, research stations, and privately-owned fragments at and surrounding the Las Cruces and La Selva Biological Stations in Costa Rica. We also conducted a census of primate populations, quantified forest characteristics, examined microclimate variation, and conducted surveys of local communities to provide socioecological context. Results indicated that the largest differences in environmental contamination occurred at the national level with Las Cruces having significantly higher legacy pesticide levels (15.8 pg/m^3) than La Selva (4.6 pg/m^3), while La Selva had significant higher CUPs (566.7 pg/m3) and PBDEs (7.7 pg/m^3) than Las Cruces (42.0 pg/m^3, 3.7 pg/m^3). At a regional scale, national parks had the lowest levels of CUPs and OPEs, but this was not the case for PBDEs or legacy pesticides, suggesting that long-term exposure to pollutants has had an effect on protected areas. Current studies are examining how this landscape of pollution translates into exposure and biological effects through pollutant and biomarker analyses of primate feces.

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Stable Isotope Analyses of Skeletal Remains from the Copper Age Burials at Valencina-Castilleja (Seville): Dietary Patterns and Regional Comparisons

ANNA J. WATERMAN[1], MARTA DÍAZ-ZORITA BONILLA[2] and ROBERT H. TYKOT[3]

[1]Biology, Mount Mercy University, [2]Prehistory, University of Tübingen, [3]Anthropology, University of South Florida

In this study stable isotope analysis ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) was completed on skeletal remains from human burials at the Copper Age site of Valencina-Castilleja (Seville) in southwestern Spain. The Copper Age constitutes a dynamic time period in southern Spain with signs of increasing social complexity. Agricultural settlements flourished and the archaeological record provides evidence of large population aggregations around ditch-enclosed settlements. Information about dietary variation within settlements and across regions can help us elucidate local subsistence patterns and regional interactions. The analyses completed in this study allow us to examine local patterns of animal and plant consumption. In order to discern regional patterns, these data are compared with those from other contemporaneous Southwestern settlement sites in the Iberian Peninsula. The bone collagen data suggests protein mainly came from C_3 plants and terrestrial animals with limited marine input. The apatite data reflects more variation in individual fat and carbohydrate intake. These dietary patterns are consistent across the Southwestern Iberian Peninsula and likely indicates that agriculture and animal husbandry practices were similar

across the region. The $\delta^{18}O$ values for some sampled individuals may indicate that they were recent migrants into the region.

Periodontal health and the lifecourse approach in bioarchaeology

JAMES T. WATSON[1,2] and ALEXANDRA TUGGLE[3]

[1]Arizona State Museum, University of Arizona, [2]Anthropology, University of Arizona, [3]Anthropology, The Ohio State University

Periodontal 'health' is essential to maintaining a foundation for attachment, stability, and retention of teeth. The concept of 'health' is more than the absence of disease and is therefore problematic among both clinicians and in bioarchaeologists. The challenge is defining what physical expression/degree within a disease process would begin to affect an individual's well-being.

Here we apply a lifecourse approach to the measurement of periodontal disease (CEJ-AC: distance from CEJ to alveolar crest with dental probe) at M1 in a prehistoric sample (N = 162) from the American Southwest (Mogollon archaeological culture) to test the hypothesis that age and sex differences bear the greatest impact on the expression of periodontitis.

CEJ-AC at M1 increased significantly (p<.001) across age stages from 3.5±6.5mm (15-20yo) to 23.3±4.9mm in the final stage (50-60yo). CEJ-AC at M1is more than double among females compared to males in the 20-30yo (F: 6.4±3.1mm vs M: 3.5±2.1mm; p=.004) and 30-40yo (F: 4.2±4.1mm vs M: 8.1±3.6mm; p<.001). Results support the hypothesis that periodontal disease can be measured across the lifecourse. They also demonstrate that reproductive-age females suffered disproportionately from periodontal tissue loss. Bacterial infection, chronic gingivitis, and bony resorption cause the physical symptoms of periodontal disease; but are often not accompanied by pain or altered functionality. The penultimate outcome of the disease process is tooth loss, which can affect functionality and quality of life. Periodontal 'health' is therefore best interpreted/conceptualized in bioarchaeological samples around the point that alveolar recession destabilizes the tooth and results in loss and altered functionality.

Who's That? Has Captivity Affected Nocturnal Aye-Ayes (*Daubentonia madagascariensis*) Vocalization Repertoire?

DAVID Q. WATTS and LISA M. PACIULLI

Biological Sciences, NC State University

Animals use varying methods to communicate. Vocal communication of nocturnal species potentially contains more information than diurnal species' because they cannot rely mostly on sight. Aye-ayes (*Daubentonia madagascariensis*) are a nocturnal lemur (Family: Lemuridae) that make six vocalizations in the wild to convey location, aggression, and converse with potential mates (Stanger & Macedonia, 1994). Much is still not known about aye-aye vocalizations, including whether identifying information is transmitted in vocal calls. In this study, the vocalizations of captive aye-ayes at the Duke Lemur Center were examined to see whether or not they contained information about the identity of the caller. A Sennheiser ME66 microphone was placed through the ceiling of cages, and nine aye-ayes (three male, six female) were presented with a novel object (a box wrench or human) for five minutes to elicit vocalizations. Vocalizations were recorded with a Tascam DR-680MKII audio recorder. The recordings were analyzed with Adobe and Cornell University software to determine if there were any unique features, such as frequency, amplitude, and duration linked to specific individuals' vocalizations. A total of forty-five vocalizations were recorded. Results indicate that while there were some slight differences between individual aye-aye vocalizations (*e.g.*, duration and amplitude range), they were not significant. One reason could be that the captive aye-aye vocalization repertoire has diminished due to a lack of selection from decreased exposure to predators in captivity. This study should be repeated on more captive aye-ayes, and include a fake predator to see if the sixth vocalization is emitted.

The evolution of body size in the diverse lesser apes

DANIEL C. WAWRZYNIAK[1] and SERGIO ALMÉCIJA[1,2]

[1]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, [2]Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona

The highly specialized locomotor behaviors exhibited by extant hylobatids are generally considered to have evolved alongside a reduction in body size from the last common ancestor of all hominoids. However, among the four currently-recognized hylobatid genera there is a greater variation in body size than usually recognized. Furthermore, the large array of body mass estimates for putative stem hominoids, as well as a lack of early fossil hylobatids, and the still contentious phylogenetic relationships within this clade make the reconstruction of body size evolution in hylobatids problematic. Within the context of anthropoids, this study models the evolution of body mass in hylobatids and the hominoid last common ancestor. Using a large sample of extant primates, the stem catarrhine *Aegytopithecus zeuxis*, and the stem hominoid *Proconsul africanus*, ancestral body size reconstructions were estimated under three evolutionary models: maximum likelihood under constant variance and multiple variance Brownian motion (BM), and multi-rate BM using reversible jump Markov chain Monte Carlo (MCMC). Results are generally consistent for hylobatids among the three methods, and predict a body mass of ~8.5-9 kg for the last common ancestor of this clade. This is just larger than in *Nomascus*, suggesting that the ~11kg *Symphalangus syndactlyus* is secondarily enlarged, while ~6.9 kg *Hoolock* and especially ~5.5 kg *Hylobates* have continued a trend of reduction since the hominoid last common ancestor. Interestingly, the geographic range of *Symphalangus* falls entirely within the range of *Hylobates*, suggesting that divergence in body size among hylobatids may be coincident with an ecological niche differentiation.

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It's what's on the inside that counts: a comparative analysis of innominate microarchitecture across primates, marsupials, rodents and treeshrews

NICOLE M. WEBB

Dept. of Anthropology, The Graduate Center, CUNY, New York Consortium in Evolutionary Primatology, (NYCEP), Dept. of Anthropology, Lehman College, CUNY, Dept. of Paleoanthropology, Senckenberg Research Institute and Natural History Museum

The pelvis is ideal for studies of skeletal loading as it frequently encounters high forces at the hip joint, especially during hindlimb-dominated locomotion. Despite trabecular bone's argued functional affinities, the exact biomechanical influences shaping its architecture remain difficult to isolate. This is due to both methodological limitations and the complex interplay of factors like allometry and phylogenetic constraint. To explore these aspects further, a broad comparative sample of bipedal and quadrupedal mammals of varying sizes, yet comparable locomotor repertoires, are evaluated to assess how reliable trabecular morphometrics are for inferring locomotor behavior.

Trabecular samples, scaled by acetabulum length, were digitally segmented from µCT scans of the superior acetabulum for eutherian and metatherian mammals (n=153) with a resolution range of 18-80µm. Relative resolutions were calculated via an approach from the literature to insure methodological accuracy when comparing bone volume fraction (BV/TV), trabecular thickness and degree of anisotropy (DA) across this diverse sample.

Results show differences in DA values across locomotor categories (p<0.05) that appear independent of body size (r^2=.056). In rodents, bipedal taxa have statistically supported, higher DA values compared to their quadrupedal counterparts. Further, bipedal rodents and marsupials have indistinguishable DA means despite differences

in size and phylogenetic relatedness.Within primates, arboreal taxa are more anisotropic than terrestrial taxa, particularly knuckle-walkers and bipeds. Although BV/TV statistically differentiates arboreal from terrestrial taxa across groups ($p<0.05$), primates produce similar means for bipeds, vertical leapers and suspensory taxa, all of which utilize orthograde trunk posture during locomotion. Functional and phylogenetic interpretations are discussed.

Levantine Late Pleistocene *Homo* heterogeneity as revealed by postcanine dentition

GERHARD W. WEBER[1,2], CINZIA FORNAI[1,3], VIKTORIA A. KRENN[1,2], HILA MAY[4], RACHEL SARIG[4] and ISRAEL HERSHKOVITZ[4]

[1]Department of Anthropology, University of Vienna, [2]Core Facility for Micro-Computed Tomography, University of Vienna, [3]Institute of Evolutionary Medicine, University of Zurich, [4]The DanDavid Laboratory for the Search and Study of Modern Humans, Sackler Faculty of Medicine, Tel Aviv University

Homo sapiens has been present in eastern Africa since MIS6 and reached west Asia at least during the subsequent interglacial. The fossil remains from Qafzeh cave (Israel, 120-90kya) might be among the first modern humans migrating into Eurasia, possibly also encountering archaic populations. They show a combination of modern and archaic features and morphological variation within the site has been described as being remarkably high. Amud cave (Israel, 70-50kya) is known instead for Neanderthal remains with peculiar characteristics, stimulating discussions about hybridization. While the cranial remains are often central to debates, we focus on several postcanine maxillary and mandibular teeth (P3s, P4s, M2s) to assess morphological variation within the Qafzeh/Amud populations, compared to a sample of modern human, Neanderthal and Middle Pleistocene *Homo* specimens. The dentine crowns were represented by landmarks and semilandmarks collected from µCT data. The 3D landmark configurations were analyzed using geometric morphometrics which allow investigating shape variation. The Qafzeh teeth showed typical patterns such as a buccal shift of the occlusal ridge in upper premolars, rather large hypocones in the upper M2, and a heart-shaped occlusal ridge for the lower M2. Most, but not all, Qafzeh teeth cluster clearly with modern humans and variation is indeed noticeably high. Amud, represented only by upper P4 and M2 owing to heavy tooth wear, shows a Neanderthal shape, but higher premolar crowns and a marked reduction of the talon in M2. Factors explaining the shape heterogeneity of those Levantine Late Pleistocene *Homo* still need to be explored.

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Patterns of genomic diversity on the X chromosome and autosomes reveal different demographic histories across macaque lineages

TIMOTHY H. WEBSTER[1] and BRENDA J. BRADLEY[2]

[1]School of Life Sciences, Arizona State University, [2]Center for the Advanced Study of Human Paleobiology, The George Washington University

Signals of natural selection and demographic history can be identified via analyses of genomic data. However, these forces can leave similar signals in any one region of the genome, complicating the reconstruction of population history. Contrasting information from DNA with different modes of inheritance (e.g., the autosomes and sex chromosomes) can be used to disentangle the relative effects of these forces. For species with relatively similar patterns of social organization, such as the macaques (genus *Macaca*), the ratio of genomic diversity on the X chromosome and autosomes (X/A ratio) can be especially powerful for exploring relative differences in population history. We used exome sequencing to investigate patterns of genomic diversity in eight species of macaque (70 individuals total). Macaque social organization is broadly uniform—they live in multimale-multifemale groups and exhibit male dispersal, female-biased sex ratios, promiscuous mating, and more reproductive skew in males than females. Therefore, we predicted that X/A ratios should be greater than 0.75 in all lineages. However, in all species, this ratio fell well below 0.75. We found that decreased ratios were due, in part, to male mutation bias and more diversity-reducing selection on the X chromosome than autosomes. We further found that differences among macaque lineages in X/A ratios were driven by historical changes in population size. We finally discuss other possible factors influencing X/A ratios and highlight the need for better models to fully explore and parse the effects of selection and demography on the genome.

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Using dental metric analysis to understand prehistoric population variability on the north carolina coastal plain

KARA D. WEIDNER and MEGAN PERRY

Anthropology, East Carolina University

Biodistance studies can quantify intra- and inter-population relatedness through non-metric and metric skeletal variables. In this study, dental metric traits of two linguistically distinct Late Woodland (AD 800-1650) populations, the Algonquian and Tuscarora-speaking groups within the North Carolina coastal regions were assessed to determine if presumed linguistic barriers led to a reduced gene flow. Previous research by Kakaliouras and Killgrove using cranial and dental non-metric traits identified few significant differences in frequencies of these traits between the Algonquian and Tuscarora, suggesting little genetic differentiation between the two groups. This research using the dental metrics of 164 Algonquian and 53 Tuscarora individuals found that the Tuscarora had significantly less variation in only the maxillary first molar buccal-lingual B-L measurement compared to the Algonquian and the combined samples (Levene's $F=5.1127$, $p=0.0070$), but otherwise identified no overall significant differences in variation (Van Valen $F=0.053$, $0=0.9947$). In addition, the only difference in mean dental measurements that existed between Algonquian and Tuscarora groups was the maxillary first molar B-L measurement ($t=1.975$; $p<0.001$). These results confirm those utilizing other cranial and dental non-metric traits, and indicate that genetic dissimilarity did not follow that of language variability. Furthermore, one site linguistically categorized as Tuscarora but which shows a mixture of Algonquian and Tuscarora culturally-affiliated artifacts, was indistinguishable from either group, further supporting genetic admixture regardless of linguistic or other cultural differences.

Dental caries and oral health in the initial contact period Guale, St. Catherines Island, Georgia

KENDRA S. WEINRICH[1], CLARK S. LARSEN[2], BARBARA J. BETZ[2] and LEIGH A. OLDERSHAW[2]

[1]Anthropology, Beloit College, [2]Anthropology, The Ohio State University

Dental caries is an infectious disease process involving focal demineralization of dental hard tissues from acid byproducts of oral bacterial fermentation of dietary carbohydrates. Carious lesions provide a record of diet and oral health outcomes in a wide range of populations globally. Analysis of a skeletal series from the 16th century Fallen Tree site, St. Catherines Island, Georgia, provides the opportunity to document oral health during initial European contact well preceding intensive contact decades later during the 17th century mission period. We test the hypothesis that oral health declined in the Fallen Tree community preceding the establishment of the Spanish mission (Santa Catalina de Guale, ca. AD 1600-1680). Statistical treatment of dental caries data for 38 individuals from the prehistoric preagricultural period (PP), 20 individuals from

the prehistoric agricultural period (PA), and 49 individuals from the initial contact period Fallen Tree site (IC) revealed dramatic and significant increases in prevalence of carious teeth for PP, 1% (n=462); PA, 7% (n=228); IC, 18% (n=965); and of carious individuals for PP, 8% (n=38); PA, 30% (n=20); IC, 68% (n=47) ($p \leq 0.05$; chi-square). These findings reveal a clear pattern of increase in maize consumption and associated oral health decline occurring decades prior to the intensification of contact between Guale and Europeans and the accompanying dramatic social, health, diet, economic, and behavioral changes during the mission period in the 17th century.

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The Impact of Status and Sex in Mortality in a Hungarian Avar Period Population Assessed Using Hazard Analysis

KATHERINE E. WEISENSEE[1], ANNE K. SHILLINGLAW[1] and ZSOLT BERECZKI[2]

[1]Sociology, Anthropology and Criminal Justice, Clemson University, [2]Department of Biological Anthropology, University of Szeged

This research examines paleodemographic trends in an Avar period archaeological series from southern Hungary that dates from the 7th-9th centuries. The skeletal remains from the cemeteries of Szeged-Kiskundorozsma-Kettôshatár were assessed for demographic characteristics along with other nonspecific stress makers. The archaeological site is divided into two burial sites, Kiskundorozsma-Kettôshatár I and II (KKI and II). Archaeological analysis of the grave goods associated with the burial sites suggests that the KKII cemetery contains individuals of higher status in comparison with the first cemetery due to the quality and quantity of grave goods associated with these burials. This study examines differences in the hazard of mortality for adults between the two cemeteries. In addition, sex differences in hazard of mortality is also examined. Age-at-death in adults is estimated using transition analysis. Age-at-death from both cemeteries is pooled to estimate the Gompertz hazard of mortality and high status (KK II) is modeled as a covariate impacting the baseline hazard. Sex differences were also assessed pooling the samples and modeling sex as a covariate. The preliminary results suggest that the lower status Cemetery I individuals were at reduced risks of mortality compared to the higher status Cemetery II individuals. The analysis of sex differences in the pooled sample of males and females shows that males in the sample are at reduced risks of mortality compared to females. These results will be discussed in relationship to non-specific stress markers documented in the collection along with variation in growth and development among the two cemeteries.

Body size and social status in medieval and post-medieval Italy: A comparison of Alba (CN) and Trino (VC)

NICOLE M. WEISS[1], GIUSEPPE VERCELLOTTI[1], ROSA BOANO[2], MARILENA GIROTTI[2] and SAM D. STOUT[1]

[1]Anthropology, The Ohio State University, [2]Scienze della Vita e Biologia dei Sistemi, Università degli Studi di Torino

A considerable amount of research in biological anthropology has focused on elucidating the relationship between body size and life conditions experienced by past people. Generally speaking, high status individuals tend to be taller and more robust than those of low status, with size differences typically more notable in males. The purpose of this work was to determine if these relationships could also be observed in the medieval and post-medieval (seventh – eighteenth centuries CE) Italian bioarchaeological collection of San Lorenzo di Alba, which comprises both high and low status individuals. Monte Carlo analysis was used to assess differences in skeletal element size. Significant differences were found between males of high and low status for the following measurements: maximum length of the radius ($P = 0.020$), maximum length of the tibia ($P = 0.014$), condylo-malleolar length of the tibia ($P = 0.010$), maximum diameter of the humeral head ($P = 0.011$), and epicondylar breadth of the humerus ($P = 0.003$). In contrast, no significant status-based differences in body size were observed between the female subsamples ($P > 0.05$). Results suggested that the aforementioned pattern of intrapopulation variation was indeed observed at Alba, adding to the narrative of the past people who once lived there. Future work will further examine status-based differences in Alba to better understand why these particular patterns of variation emerge.

A forensic anthropology user interface for automating search using remotely sensed data from unmanned aerial vehicles: preliminary findings

DANIEL J. WESCOTT[1], DEREK T. ANDERSON[2], ROBERT MOORHEAD[3] and BRYCE MURRAY[2]

[1]Anthropology, Texas State University, [2]Electrical and Computer Engineering, Mississippi State University, [3]Geosystems Research Institute, Mississippi State University

Forensic anthropologists are commonly requested to aid in locating clandestine remains and in mapping potential outdoor crime scenes. Our goal is to provide search and recovery teams with scientifically based best practices, a standard operating procedure, and tools for conducting non-invasive searches for clandestine human remains and documenting scenes via multi-sensor enabled unmanned aerial vehicles. In May 2017, experiments were performed at the Forensic Anthropology Research Facility in Texas using an octocopter with precise positioning, a 270 band hyperspectral visual and near IR (VNIR) camera, and longwave thermal and visual spectrum cameras for 3D (via Structure from Motion (SfM)). An open source user interface (UI), in QT and Octave, was developed. This UI a) simplifies visualization of spectral, spatial and SfM geospatial data; b) allows users to select and compare measurements (in the data and to materials from a USGS data set); and c) provides supervised (adaptive cosine estimator (ACE) and convolutional neural network (CNN)) and unsupervised (Reed-Xiaoli (RX) detector and visualization of assessment of (cluster) tendency (VAT)) algorithms. Preliminary results indicate 1) an ability to detect (via the RX algorithm) cadaver decomposition islands in thermal and VNIR; 2) an ability to detect skin and local vegetation anomalies in NVIR (via ACE, shallow CNN and normalized difference vegetation index (NDVI)); and 3) an inability to build SfM 3D grave features due to vegetation. This engineering and anthropology collaboration highlights successes and failures, with recommendations on next steps.

Dominance and Migration in Kinda Baboon Males

ANNA H. WEYHER and JASON M. KAMILAR

Anthropology, University of Massachusetts Amherst

In baboons, male dominance hierarchies are generally linear and aggression between males is common. An alpha male's tenure can vary from a few months to two or more years. Here, we present the first long-term data of male Kinda baboon dispersal patterns and dominance relationships in a group from Kasanka National Park, Zambia. Over the six year study period, the group ranged in size from 54 to 74 and non-natal adult males fluctuated from four to six individuals. We observed nine non-natal and eight natal adult males emigrate from the group and seven males immigrate into the group. We inferred male ordinal ranks using EloRatings because they allow us to track changes through time. Ratings were calculated on the basis of displacement interactions, which were observed either during focal samples or as ad libitum observations. Residency in the group was taken into account, following previous studies. We found that four adult males had alpha status over the study period. Tenure length ranged from 16 to 36 months. At the beginning of the study two males showed a type of co-dominant alpha status where two males switched back and forth between alpha and beta positions. This study is important as it sheds light on male dominance and male dispersal in a previously unstudied baboon taxon. Long tenures and the

prevalence of non-aggressive immigrations appear to be distinct in this species.

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Defining and recording periodontal disease and gingivitis in archaeological assemblages: a perspective from ancient Sudan

REBECCA J. WHITING[1,2], DANIEL ANTOINE[2] and SIMON HILLSON[1]

[1]Institute of Archaeology, University College London, [2]Department of Ancient Egypt and Sudan, The British Museum

Despite extensive research on the aetiology of periodontal disease in living patients, the condition can be difficult to record in the dry bone of archaeological collections. Recording methods can be problematic and its association with other pathological changes in the oral environment are often not considered. This study examines the Kerr method for recording periodontal disease and its suitability to recognise the different clinical stages of disease progression. Three sites in ancient Sudan were used to examine the applicability of the method (n=256). The appearance of the observable interdental alveolar bone was recorded. Differences in the prevalence of alveolar bone with signs of pathological changes were seen between periods, as well as sex and age categories. Both the *Kerma Ancien* (2500-2050BC) and early Medieval (AD500-700) periods showed higher prevalence of periodontal disease than the later Medieval group (AD1100-1500). Statistically significant differences occurred between the sexes at the two Medieval sites, with males showing higher prevalence than females. The *Kerma Ancien* assemblage had similar prevalence between the sexes. However, periodontal disease is a dynamic process with periods of progression and healing. Often considered as a sign of oral 'health' or 'non-health' in an archaeological context, it should be noted that only the state of change at death is observed. The Kerr approach appears to be a suitable method for recording the complex changes that can affect the periodontium in a manner that reflects the clinically recognised progression of the disease, allowing for more nuanced interpretation of archaeological populations.

Effects of Environment and Relatedness on the Gut Microbiome of Ugandan red colobus monkeys

TABOR WHITNEY[1], DIANA CHRISTIE[1,2], MARIA J. RUIZ-LOPEZ[2], COLIN A. CHAPMAN[3,4], TONY L. GOLDBERG[5,6] and NELSON TING[1,2]

[1]Anthropology, University of Oregon, [2]Institue of Ecology and Evolution, University of Oregon, [3]Anthropology, McGill School of Environment, [4]Biology, Makerere University Biological Field Station, [5]Pathobiological Sciences, University of Wisconsin-Madison, [6]Global Health Institute, University of Wisconsin-Madison

The gut microbiome consists of microbial communities that reside in the gastro-intestinal tract of living organisms. Variation in this system has been linked to health outcomes in human and animal models by affecting digestion, immune system development, and pathogen invasion. However, we still lack a complete understanding of the factors that shape gut microbiome variation, particularly in wild primates. The central aim of this research is to further test how forest fragmentation is associated with gut microbial diversity in the Ugandan red colobus monkey. We sequenced the 16S rRNA hypervariable V-4 region to characterize the gut microbiome from 106 genotyped individuals across eight social groups inhabiting different forest types within Kibale National Park and its surrounding area. We compared alpha diversity in the gut microbiome of individuals inhabiting fragmented versus continuous forest and did not find a simple relationship between gut microbial diversity and forest fragmentation. While individuals residing in some fragments had lower gut microbiome alpha diversity, those residing in well-protected fragments retained gut microbial diversity levels comparable to residents of continuous forest. Furthermore, we discovered numerous highly related red colobus monkey dyads between forests, which allowed us to assess the affects of genetic relatedness on gut microbial similarity. We found that environment plays a larger role than genetic relatedness in shaping the gut microbiome. Our research thus reinforces the role that environment plays in shaping within-species gut microbial variation with potential implications for the conservation of threatened populations in fragmented landscapes.

Cranial Modification as a Marker of Social Identity in the Southern Hinterlands of the Wari

ANNA F. WHITTEMORE and TIFFINY A. TUNG

Anthropology, Vanderbilt University

This study examines cranial vault modification (N=69 crania) from the mortuary and ritual site of La Real (600 – 1000 CE), located in the Majes Valley of Southern Peru. We investigate the frequency and patterning of this form of body modification. If the community was comprised of a homogenous social group, then we expect to see one cranial modification style dominate the assemblage. In contrast, if La Real was a regional mortuary locale that numerous social groups used to bury their dead, then we expect to observe several cranial modification styles (e.g., tabular erect, tabular oblique, annular, and unmodified). Previous research shows that this form of body modification was a marker and maker of group belonging and social identity.

This study employed gross morphological analysis to assess 1) general style of modification, 2) modification apparatus (when possible), and 3) additional features such as asymmetry and elevation or depression along sutures. Each observation was coded, described qualitatively, photographed, and if the cranium was complete, we made a 3D scan of it. Among the 69 crania, 83% were modified, near-exclusively in a style characterized as "slight tabular erect". There were no significant differences in modification rates between males and females (p=0.44, Fisher's exact), or between the two burial contexts (cave vs. rectangular structure) at the site (p=0.068, Fisher's exact). The overwhelming regularity of cranial modification style suggests that the population buried here was local and socially homogeneous; it does not appear that diverse groups of people interred their dead at La Real.

This research was funded by Dr. Tiffiny Tung's NSF grant, #1420757, A Bioarchaeological And Isotopic Study Of Social Organization, Violence, Health And Diet.

Spatial variation in the diet of a Tana River mangabey (*Cercocebus galeritus*) group

JULIE WIECZKOWSKI

Anthropology, SUNY Buffalo State

The Tana River mangabey (*Cercocebus galeritus*) is an endangered monkey endemic to the lower Tana River in Kenya. Although the mangabey inhabits approximately 40 forest fragments, studies on their feeding ecology have been undertaken in only five. However, because the fragments are spatially and temporally variable in structure and species composition, even investigating ecology in neighboring forests can contribute to our understanding of the mangabey's ecological flexibility. I followed one group that used three fragments for one year, using 10-minute scan samples every half-hour to collect feeding data during 3-day follows twice a month. I also counted reproductive-sized individuals of 19 diet species (representing 80.6% of their diet) in their 46.75 hectare home range to characterize diet species composition. I calculated percent similarity among the three fragments in tree species abundance, entire diet, and diet of the 19 species, as well as selection indices for each of the 19 species in each fragment. The three fragments were only 69.8% similar in the 19 tree species (pairwise comparisons: 74.1%, 76.4%, and 84.1%). The group's diet was only 44.6% similar for all diet species (pairwise comparisons: 50.3%, 54.6%, and 65.4%) and 47% similar for the 19 species (pairwise comparisons: 51.4%, 54.9%, and 68.3%) across the three fragments. Selection indices varied greatly among and within the 19 species. The three forest fragments were more similar in diet species composition than

the group's diet was in each fragment; this, along with the variable selection indices, highlights the mangabey's ecological flexibility.

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Spatial memory of semi-free ranging *Lemur catta*

MATTHEW E. WILKENS[1] and ELENA P. CUNNINGHAM[2]

[1]College of Dentistry, New York University, [2]Basic Science and Craniofacial Biology, NYU College of Dentistry

To gain a better understanding of the evolution of primate cognition, it is essential that we study the cognitive skills employed by lemurs to navigate and recall locations of important resources. We examined the ability of a group of seven semi-free ranging *Lemur catta* to remember the location of 10 resources. The study took place between March 21st and May 13th 2017 in a 3.5-acre forest at the Lemur Conservation Foundation in Florida, concurrent with a study of olfaction. We analyzed the groups' travel in relation to ten test sites, which were located 6-21 m from a habitual path. Subjects had detected and eaten cantaloupe once at each site.We predicted that if they remembered feeding at these locations, they would revisit the sites when they were not baited. Subjects did not visit any test locations prior to detecting resources at the site and feeding there, indicating that these sites were not part of their habitual path. Subjects revisited 9 of 10 sites where they had previously fed when no bait was present; they returned to 4 of the sites twice. Five revisits occurred on the same day as the initial visit (x = 210 min, range = 82-446) and 7 revisits were after a delay of more than 1 day (x = 9.6 days, range = 1-30 days). Our results suggest that *Lemur catta* possess long-term spatial memory and can remember locations of a minor food sources after feeding there once.

Estimating African ancestry in two historic ossuaries in New Spain

CATHY WILLERMET[1], HEATHER J.H. EDGAR[2], EMILY MOES[2] and COREY S. RAGSDALE[3]

[1]Department of Sociology, Anthropology, and Social Work, Central Michigan University, [2]Department of Anthropology, University of New Mexico, [3]Department of Anthropology, Southern Illinois University Edwardsville

The African population in the Viceroyalty period of New Spain (1535-1821) is commonly thought to have been small. However, by 1640, the most free African-derived and the second most enslaved African-derived individuals in the New World were living in Colonial Mexico. By 1810, free Afro-Mestizos comprised at least 10% of the population. A caste system divided the population. Caste, based largely on skin color and admixture patterns, influenced an individual's social class and shaped economic and political opportunities, including the right of parish burial. Parish records and historical accounts suggest that population levels of castes that include African ancestry should be low, around 10%.

We collected dental morphological trait and cranial macromorphoscopic data on 89 crania from two colonial Mexico City parish ossuary samples: Catedral (n=26), a middle-upper class parish in the city center, and Soledad (n=63), a poorer parish to the southeast. We collected cranial macromorphoscopic data using Osteoware standards and analyzed for ancestry using Hefner's method; we used ASUDAS standards for dental morphology and analyzed for ancestry using Edgar's method. We performed multidimensional scaling (MDS) of both datasets in PAST. Ancestry estimates using cranial macromorphoscopic data indicate between 23%-45% of the individuals code as having African ancestry. Chi-square analysis showed significant differences of cranial macromorphoscopic traits in MDS coordinates among individuals, but no significant differences between parishes. Results suggest a greater African-derived trait presence than would be predicted from historical records. This result helps us better understand biological effects of Spanish colonization in the colony of New Spain.

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The tolerance, provisioning, and wounds of the introduced vervet *(Chlorocebus sabaeus)* population in Dania Beach, Florida

DEBORAH (MISSY) WILLIAMS[1] and CHERYL A. RUIZ[2]

[1]Integrative Biology, Florida Atlantic University, [2]Social and Behavioral Sciences, Broward College

Understanding human attitudes and perceptions towards primates can better help facilitate conservation initiatives as the depletion of natural lands increases human-nonhuman primate interactions. Vervets are a generalist species that adapt readily to anthropogenic landscapes and are considered a pest primate in most areas. This study focused on the introduced urban vervet population in Dania Beach, Florida. The goal was to: 1) survey the community about their attitudes and perceptions about the monkeys, 2) record frequency of provisioning by the community, and 3) examine the impact of provisioning on the monkeys. Of the community surveys completed (n= 165), 14% reported regularly provisioning the monkeys and 57% stated they would feed the monkeys to help them survive. This provisioning behavior was reported as a way to connect with nature, however, provisioning is well documented to have negative impacts on wildlife. Results from field observations of human-nonhuman interactions validate results from surveys. From January 2016-January 2017 we recorded 427 provisioning events through direct observation and camera trap photos. During this same time, we documented 67 wounds/injuries. The frequency of wounds in the population is likely due to increased aggression between individuals when feeding in close proximity during provisioning events. Interestingly, when provisioners were informed about the potential relationship between provisioning events and wounds, they would continue to feed the monkeys. Ongoing research is further analyzing the relationship between provisioning and increased aggression, and how best to educate the public on the negative impacts of feeding.

Maxillary first molar outlines of *Gorilla gorilla* and *Pan troglodytes*: a comparison of taxon and site differences using elliptical Fourier analysis

FRANK L. WILLIAMS and KATHERINE M. LANE

Anthropology, Georgia State University

Extensive variation exists in African ape molars. Understanding how this variation is patterned between and within taxa provides a context to estimate the variability that might be expected in fossil apes. Maxillary first molars of *Gorilla gorilla* (n = 19) from the Democratic Republic of the Congo (DRC) and Cameroon, and *Pan troglodytes* (n = 14) from the DRC and Kivu, Uganda, were molded at the Royal Museum for Central Africa, Tervuren, Belgium and the Museum of Comparative Zoology at Harvard University. Occlusal outlines of the dental casts were captured using photostereomicroscopy and non-landmark smooth tracing methods. The resulting binarized images were subjected to elliptical Fourier analysis using SHAPE v1.3, which extracted principal components (PC) scores from the amplitudes of the harmonics. *Gorilla* and *Pan* are different on PC2 (p = 0.038) and PC5 (p < 0.01) although the other PC axes show broad overlap between genera. A greater clustering of the Cameroon *Gorilla* population exists compared to the more dispersed DRC individuals. However, nonparametric tests fail to identify significant differences in PC scores between *Gorilla* groups. The sole *Pan troglodytes* individual from Kivu is distinctive in its maxillary first molar occlusal shape compared to those from the DRC. Although some shape distinctions may be the result of site differences, this individual also exhibits extensive mandibular condylar arthritis and numerous dental abscesses. Taxonomic and site distinctions in maxillary first molar occlusal outlines of the African apes are present, but

subtle, and may be limited to extreme differences among individuals.

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Relative size and scaling of the lumbo-sacral joint in fossil hominins: Implications for function and phylogeny

SCOTT A. WILLIAMS[1,2,3], THOMAS C. PRANG[1,2], MARK W. GRABOWSKI[4,5,6], MARC R. MEYER[7], PETER SCHMID[3,8], STEVEN E. CHURCHILL[3,9] and LEE R. BERGER[3]

[1]Center for the Study of Human Origins, Department of Anthropology, New York University, [2]New York Consortium in Evolutionary Primatology, NYCEP, [3]Evolutionary Studies Institute and Centre for Excellence in PalaeoSciences, University of the Witwatersrand, [4]Paleoanthropology, Senckenberg Centre for Human Evolution and Palaeoenvironment (HEP), Eberhard Karls University of Tübingen, [5]Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences, University of Oslo, [6]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, [7]Department of Anthropology, Chaffey College, [8]Anthropological Institute and Museum, University of Zurich, [9]Department of Evolutionary Anthropology, Duke University

Body proportions vary across taxa and relate to body size and locomotor mode. In fossil hominins, body proportions can inform reconstructions of positional behavioral patterns (i.e., arboreality and terrestriality), biomechanics, and evolutionary histories. Limb proportions and limb joint sizes have been investigated extensively, whereas the load-bearing joints of the axial skeleton are understudied. Here, we investigate the relative size and scaling of the lumbo-sacral joint (LSJ) in early hominins. To maximize the number of fossil hominins included and avoid the cumulative error associated with regressing LSJ area against estimated body mass, we use femoral head diameter (or predicted femoral head size based on SI acetabular diameter) and analyze these variables in large samples of extant hominids (N=250) using ordinary least-squares regression. Results suggest that both female (A.L. 288-1) and male (KSD-VP-1/1) *Australopithecus afarensis* have large (human-sized) LSJ areas, whereas *A. africanus* (Sts 14 and StW 431), *A. sediba* (MH2), and *H. erectus* (BSN49/P27 and KNM-WT 15000) have undersized LSJ areas which fall outside the 95% confidence intervals of the regression line and 95% confidence ellipses of the data for modern humans. These results are consistent with previous studies showing that L5 and S1 grossly underestimate body mass in most early hominin taxa (by approximately one-half to one-third) compared to more commonly used estimators such as femur measurements. We discuss the functional and phylogenetic implications of the dichotomy between *A. afarensis* and modern humans on the one hand, and South African australopiths and *Homo erectus* on the other.

Examination of cremation practices at River Styx, a unique ceremonial center in North Central Florida

KYLIE WILLIAMSON[1], NEILL WALLIS[2] and JOHN KRIGBAUM[1]

[1]Anthropology, University of Florida, [2]Archaeology, Florida Museum of Natural History

River Styx is a Middle Woodland (ca. AD 100-300) ceremonial center located in North Central Florida, and is believed to be evidence for the formation of the Cades Pond culture. Currently, River Styx is the only known site in prehistoric Florida where cremation was the sole form of deposition of deceased humans. Although largely ignored in the past, recent research demonstrates cremated human remains are indeed useful for bioarchaeologists and yield information on important facets of site-specific human burial practices. Considering the unique aspects of River Styx, this study examines the cremation practices to better understand Cades Pond culture and its connections to the larger Weeden Island religious complex.

This study focuses on macroscopic analyses of color and fracture patterns to investigate cremation practices at River Styx. Following Munsell color charts, results indicate two major coloration patterns, while fracture patterns are relatively consistent. The dominant color for 60% of the burials is described as "very pale brown", while 29% of the burials had relatively equal representations of "very pale brown," "light gray," and "white" fragments. Furthermore, although the utility of fracture patterns for estimating pre-burning conditions is debated, 76% of the burials demonstrated thumbnail fractures and 47% of the burials displayed warping of elements, suggesting individuals were fleshed at time of burning. Planned strontium ratio analysis of these remains will complement these studies and situate the site in regional context. Overall, River Styx offers unique insight into local burial practices, and helps answer questions surrounding the Weeden Island religious complex.

A Probable Case of Multiple Myeloma and Other Pathological Lesions Among the Inhabitants of the Early Historic Burnt Village Site, Georgia

MATTHEW A. WILLIAMSON

Department of Health and Human Sciences, Georgia Southern University

In 1966, archaeologist Harold Huscher excavated the skeletal remains of 18 individuals consisting of one male, six females, seven children, and four adults of indeterminate sex in order to rescue them from being permanently lost due to the creation of the West Point Dam Reservoir near LaGrange, Georgia. Huscher believed the site to be the Creek town of Okfuskenena that was destroyed on September 21, 1793 by an informal militia of colonists. Historical documents allege that six Creek men were killed and scalped during the raid, three women and five girls were carried off as prisoners, and the village of ten houses was plundered and burned. The remains were examined grossly, microscopically, and in one case radiographically for the presence of pathological lesions. No lesions consistent with scalping were observed. Five individuals exhibited enamel hypoplasias. An extra-sutural bone located at lambda (a so-called "Inca" bone) was noted in one juvenile. Four individuals showed evidence of osteoarthritis including lesions pathognomonic of temporomandibular dysfunction (TMD). Only two individuals, an adult of unknown sex and an adult female, exhibited carious lesions. The only periosteal lesion found was on the midshaft of a right tibia belonging to an adult female. Of particular interest is a male aged 55+ whose head had been artificially shaped in the fronto-occipital fashion and who also displayed lesions that fit with descriptions of those found on documented cases of multiple myeloma provided by Rothschild et al. (1998). The differential diagnosis of multiple myeloma will be discussed.

Dental microwear texture analysis of the Late Upper Paleolithic/Neolithic humans at Tam Hang (Northern Laos)

JOHN C. WILLMAN[1], CHRISTOPHER W. SCHMIDT[2], ASHLEY REMY[2], LAURA SHACKELFORD[3] and FABRICE DEMETER[4]

[1]Anthropology, Washington University in Saint Louis, [2]Anthropology, University of Indianapolis, [3]Anthropology, University of Illinois at Urbana-Champaign, [4]Departement Homme Nature Societe, National Museum of Natural History

The human burials from Tam Hang provide a rare opportunity to study Late Pleistocene human paleobiology in a non-Western Eurasian context. As such, this study addresses dietary variation at Tam Hang using dental microwear texture analysis (DMTA). A white-light confocal profiler was used to examine phase II wear facets on molar casts following standard procedures. Complexity (Asfc), anisotropy (epLsar), and textural fill volume (Tfv) were calculated using scale-sensitive fractal analysis software (Sfraxâ and Toothfraxâ). Seven individuals had well-preserved microwear and were compared to previously published Pleistocene and Holocene groups. Tam Hang mean complexity (1.60) is high, and closest to Natufians and hard-diet foragers (Middle Woodland Indiana). However, two Tam Hang individuals have relatively low complexity (Asfc > 1.0) suggesting they ate softer foods, like meat. Mean anisotropy (0.0028) is low and most like the Vindija Neandertals, hard-diet foragers (Middle

Woodland Indiana), and abrasive diet foragers (Middle-Late Archaic Kentucky). However, one individual has elevated anisotropy (0.0072) indicative of tough or fibrous food consumption. Mean Tfv is relatively low (26,509), but two sub-groupings in the Tam Hang sample indicates within group variation in the consumption of mechanically challenging foods. Overall, the microwear signature at Tam Hang is heterogeneous with some emphasis on hard food consumption, and idiosyncratic variation in meat and tough food consumption. There is no patterning by age, sex, or ablation status. High within sample variation may indicate broad spectrum foraging strategies, but we cannot rule out intrusive Neolithic burials in the Late Upper Paleolithic sample at Tam Hang.

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Political transitions and weaning: interpreting childhood nutritional deficiency using interglobular dentin and Wilson bands

TERESA V. WILSON

Geography and Anthropology, Louisiana State University

The transition from the less regulated trade intensive Bronze Age (1950 – 1200 BCE) to Roman controlled city-states (63 BCE – 324 CE) would have affected the rural agriculturalists of northern Jordan. In the absence of significant differences in traditional indicators of stress (porotic hyperostosis, linear enamel hypoplasias, etc.) between these periods, alternate analyses were needed. Using dental histology, interglobular dentin (IGD), an indicator of vitamin D deficiency, and Wilson bands, a non-specific stress indicator, provided an interpretation of dietary changes. Where Wilson bands indicate timing of stress events, IGD provides an indication of the type of nutritional deficiency being experienced. The sample consisted of 100 canines from the Bronze Age (n=50) and the Roman Period (n=50). The majority of the sample (91%) have regions of IGD including 84% of the Bronze Age sample and 98% of the Roman sample. Within the entire sample, 45% show IGD throughout the entire length of the crown (36% Bronze Age and 54% Roman) and 46% show IGD in the lower half of the crown only (48% Bronze Age and 44% Roman). The highest density of Wilson bands (59%) correspond to the highest density of IGD and the typical age of weaning (~3 years). Weaning and the reduction of vitamin D in the diet of children can account for the prevalence of IGD in the lower half of the crown, but the social and political differences account for the differences in the prevalence of IGD and Wilson bands throughout the entire crown.

Sample collection was funded by the American Center of Oriental Research (Bikai Fellowship) and the King Fahd Center for Middle East Studies at the University of Arkansas.

Can we "Kickstart" science?

MELISSA A. WILSON SAYRES

School of Life Sciences, Arizona State University

As budgets of federal funding agencies fluctuate, and foundations are flooded with applications, many wonder whether crowd-funding will be able to fill the gaps in research support. This concern is especially timely for trainees as NSF-BIO eliminated the Doctoral Dissertation Improvement Grant in June 2017, though thankfully – at the submission of this abstract - the DDIG in Biological Anthropology is still active. I will synthesize current data on the effectiveness of crowd-funding for science, present a variety of platforms that have been used for crowd-funding science, and discuss the process that our lab underwent for a successful crowd-funding campaign. Running a crowd-funding campaign is a significant amount of effort and time to write, prepare, and execute that should be allocated for in lab time. Moreover, there are several charges from the crowd funding platforms, institutions, or governments, that should be accounted for when budgeting for the goal amount to raise. Finally, like other grant applications, not all crowd-funding projects meet their goals, and thus may not be awarded any funds. That said, crowd-funding campaigns have a higher funding rate than most other award opportunities. The typical amount raised with successful crowd-funding endeavors is between $2500-$5000. This amount of support can make a tremendous difference to trainees in anthropology who need to support travel, lodging, and meals at field sites. It could also help support final laboratory experiments. I will summarize the pros and cons to help trainees and labs make informed decisions on using crowd-funding to Kickstart their research.

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Facial aging in three dimensions: A shared pattern in men and women is disrupted after menopause

SONJA WINDHAGER[1], PHILIPP MITTEROECKER[1], IVANA RUPIC[2,3], TOMISLAV LAUC[2,3,4,5], OZREN POLASEK[6] and KATRIN SCHAEFER[7]

[1]Department of Theoretical Biology, University of Vienna, [2]Dental Clinic Apolonija, Zagreb, [3]Study of Anthropology, Faculty of Social Sciences and Humanities, University of Zagreb, [4]Medical faculty, University of Osijek, [5]Department for Orthodontics, Faculty of Dentistry, Univesity of Osijek, [6]Department of Public Health, School of Medicine, University of Split, [7]Department of Anthropology, University of Vienna

Facial aging results from cumulative age-related changes in the skin, soft and skeletal tissues of the face. Its manifestations reflect combined effects of gravity, facial volume loss, progressive bone resorption, decreased tissue elasticity, and redistribution of fat. Despite widespread interest (e.g., in facial reconstruction, facial recognition, aesthetic rejuvenation), thorough quantifications of facial shape changes with advancing age remain scarce. Therefore, surface scans of 88 human faces (aged 26–90 years) were analyzed via geometric morphometrics. The 32 men and 56 women were from the coastal town Split and the neighboring islands Korcula and Vis (Croatia), exhibiting considerable genetic and environmental homogeneity. Forty fixed landmarks and 554 curve- and surface-semilandmarks were used to regress facial shape upon chronological age. Male and female distributions barely overlapped. Their – close to linear – age trajectories were almost parallel, until around age 54 when the female trajectory turned sharply, likely resulting from menopausal hormonal changes. In both sexes, increasing age led to a flattening of the face as well as an overall sagging of soft-tissue resulting in a "broken" jaw-line, deepened nasolabial folds, and smaller visible areas of the eyes. Further characteristics of advanced age were relatively thin lips, a drooping tip of the nose and lengthened ears. Enhanced longevity in older ages is a main contributor to projected gains in life expectancies at birth, which doubled across industrialized countries over the last 200 years. This emphasizes the importance of understanding age dependent changes in facial morphology in older age together with their social perception.

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Ancient Mitochondrial DNA Analysis at Misión Salesiana, Tierra del Fuego

STEVIE WININGEAR[1], JOSEFINA M. B. MOTTI[2], MARIA A. NIEVES COLÓN[1,3], KELLY HARKINS[4], PAMELA GARCIA LABORDE[2], RICARDO A. GUICHÓN[2] and ANNE C. STONE[1]

[1]School of Human Evolution and Social Change, Arizona State University, [2]Núcleo de Estudios Interdisciplinarios sobre Poblaciones Humanas de Patagonia Austral, Lab. de Ecología Evolutiva Humana, Facultad de Ciencias Sociales, Universidad Nacional del Centro de la provincia de Buenos Aires, [3]Laboratorio de Genómica para la Biodiversidad, Unidad de Genómica Avanzada CINVESTAV, [4]Human Paleogenomics Laboratory, Department of Anthropology, University of California, Santa Cruz

Access to high quality full genome data has provided new ways for anthropologists to trace human movement and migration out of Africa and beyond. As a result, the large scale peopling of the world is fairly well resolved; however,

human population history at the regional and local levels have yet to be explored in many areas. Disentangling local population histories elucidates the context underlying the large scale peopling events for which we currently only have a broad understanding.

Analysis of biological data from a cemetery population at Misión Salesiana ("Nuestra Señora de la Candelaria") in Tierra del Fuego provides insight into the local population history in this region of South America. Misión Salesiana was established in 1893 primarily to Christianize the remaining local indigenous population, the Selk'nam. The cemetery at this mission contains burials that are, on average, 100 years old. After ancient DNA extraction, in-solution hybridization capture was used to recover the mitochondrial genomes from 24 individuals. Mitochondrial lineages C and D are predominately represented in the sample (appearing in 50% and 41% of the individuals, respectively). Two individuals have haplotypes which are found in European populations, which is reflective of either admixture or interment of European individuals in the mission cemetery. The whole mitochondrial genome data were analyzed for measures of diversity and the cemetery population was compared to other South American populations, both ancient and modern. These studies of diversity yield insight into both inter and intra group variation in Native South American populations.

Effect of asymmetry on data collection for dental non-metric traits

AMANDA WISSLER

Anthropology, Arizona State University

Biological distance analyses using dental non-metric traits have become an increasingly common approach for exploring kinship, migration and genetic relatedness. Despite its popularity, many aspects of the methodology are not standardized. Though seldom mentioned in the literature, trait asymmetry is not uncommon, and how to deal with it has been under-explored. This research investigates the effect of asymmetry on how different data analysis techniques influence the mean trait score.

Data on 7 non-metric dental traits from the Arizona State Dental Anthropology System (ASUDAS) were collected from 42 individuals of the Hasanlu skeletal collection housed at the University of Pennsylvania Museum of Anthropology. To investigate the impact of different data analysis procedures, differences in mean trait score among the following 5 techniques were assessed: 1) taking only the left side, 2) taking the left side with antimere substitution when the left side is unobservable, 3) taking the average of the right and left sides, 4) taking the highest score with substitution, and 5) taking the lowest score with substitution. Results demonstrate no significant differences in mean trait score among these methods except between taking the highest and lowest scores. These results suggest that even in fairly uniform data and with a small sample size, how the data is processed can have significant effects. Using scores from only one side may bias the data or oversimplify the genetic-environmental interactions at play and eliminates potentially useful information on individual variation.

Ancient DNA Analysis of Nineteenth Century Pipe Stems Recovered from a Maryland Slave Quarter

KELSEY E. WITT[1,2], JULIE M. SCHABLITSKY[3], JAZMIN RAMOS MADRIGAL[4], MARTIN R. ELLEGAARD[4], HANNES SCHROEDER[4] and RIPAN S. MALHI[5,6]

[1]Molecular and Cell Biology, University of California - Merced, [2]School of Integrative Biology, University of Illinois at Urbana-Champaign, [3]Cultural Resources Section, Maryland State Highway Administration, [4]Evolutionary Genomics Secton, Natural History Museum of Denmark, University of Copenhagen, [5]Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, [6]Department of Anthropology, University of Illinois at Urbana-Champaign

Clay tobacco pipe stems were archaeologically recovered from a slave quarter at Belvoir, a plantation site in Maryland. Many descendants of the enslaved African Americans still live in the area, and had an interest in understanding their ancestry. We attempted to use ancient DNA sequencing on four pipe stems to determine the identity of the people who used these pipes. DNA recovery was successful for one pipe stem, and the DNA damage patterns are consistent with ancient DNA. Interestingly, based on the ratio of sex chromosome DNA reads recovered, the primary user of the pipe stem was likely female. A limited amount of mitochondrial DNA was also recovered from this pipe stem. The mitochondrial haplogroup identified was L3e, an African haplogroup that is not shared with any of the researchers involved in the project. Comparison of low-coverage genomic data to that of modern worldwide populations suggests that the ancestry of the pipe smoker(s) was African. Principal component analysis showed the closest affiliation to the modern Mende population of Sierra Leone, which is consistent with the African port origins of many captives transported to Maryland. For the descendant community, ancient DNA provides a means for them to learn about their identity and ancestral origins.

The Perfect Match(es): An Evaluation of Osteometric Pair-Matching in a Commingled Context

PAIGE V. WOJCIK[1] and YASMIN CIFUENTES ARGUELLO[2]

[1]Anthropology, Indiana University, [2]Arqueologia, Universidad de San Carlos

Fragmentary commingled remains pose a challenge for bioarchaeologists attempting to associate skeletal elements. Pair-matching is typically done by matching opposite-sided bones that are similar in morphology, taphonomy, and size. The commingled skeletal collection from the Santo Domingo Church in Antigua, Guatemala makes visual pair-matching difficult due to the exposure of bones from the same individual to different burial conditions, which resulted in varying bone color and preservation. To overcome these challenges, this study uses osteometric pair-matching to determine the number of possible pairs of long bones in the Santo Domingo collection and the most likely number of individuals.

Standard postcranial measurements were taken from all long bones and fragments. A measure of asymmetry was calculated for each possible bone pair and then compared to reference tables for the ranges of asymmetry for known bone pairs. Preliminary findings show that 59.5% of left bones (n=42) were found to have multiple matches, and when the criteria was changed to each match having at least three measurements within the 90th percentile of known asymmetry, this number decreased to 37.5%. Measurements that had a larger standard deviation better discriminated potential matches, but there was not enough variation to identify single matches for most bones. Counting the bones that had no matches as distinct individuals increased the number of individuals represented by 1-4 individuals per element. Osteometric pair-matching is useful in the estimation of the most likely number of individuals in a commingled context, but cannot be used alone to match paired skeletal elements.

Methodological issues in the analysis of fragmentary and commingled subadult remains at the Ayioi Omoloyites tombs of Roman to Early Christian Period Cyprus

CHRISTOPHER A. WOLFE[1], NICHOLAS P. HERRMANN[1], KRYSTEN A. CRUZ[1], DESPO PILIDES[2] and YIANNIS VIOLARIS[2]

[1]Department of Anthropology, Texas State University, [2]Department of Antiquities, Cyprus Museum, Republic of Cyprus

Fragmentary skeletal remains present significant issues for skeletal biologists attempting to reconstruct past populations. This problem is exacerbated by additional methodological and interpretative challenges brought on by

the commingling of skeletal remains. Recent research on both fragmentary and commingled human remains from archaeological and forensic contexts has focused on advancing approaches in the analysis of adult skeletal remains, while little attention has been given to advancing the interpretative power of fragmentary and commingled subadult remains. Based on a collection of commingled human subadult remains from Roman to Early Christian (58BCE - ~500CE) period tombs from Ayioi Omoloyites in Nicosia, Cyprus, current methodological issues related to commingled subadult remains are examined and interpretative techniques are put forth to highlight the types of analyses that may be available to researchers struggling to find interpretative power in disjointed, fragmentary datasets. Using dental development and diaphyseal growth from individual skeletal elements from Tombs 47, 48, and 49 in the Ayioi Omoloyites neighborhood, Kaplan-Meier survivorship curves are formed and compared across sites from the Eastern Mediterranean that do not exhibit issues associated with commingling. In total, 210 dental arcades are scored for dental development and 324 appendicular elements are measured. Additionally, measurements of distal metaphyseal breadth and midshaft diameter are used to predict the length of fragmentary subadult long bones in conjunction with growth curve analysis as it relates to contemporaneous Eastern Mediterranean subadult populations. Implications of these relationships will show the ability to form meaningful analyses given the chaos of fragmented and/or commingled contexts.

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Engendering Neighborhood Violence in the Late Shang Dynasty, China

DANIELA WOLIN[1] and YULING HE[2]

[1]Anthropology, Yale University, [2]Institute of Archaeology, Chinese Academy of Social Sciences

Excavations at the Late Shang (ca. 1250-1050 BCE) site of Yinxu in Anyang, China have revealed the skeletal remains of thousands of human sacrificial victims. Although osteological analyses have been limited, differences in demographics and sacrificial methods suggest that aspects of social identity, such as gender, may have been an important factor for the selection or protection of an individual from specific types of ritual violence.

The presence of human sacrificial contexts in both elite and residential areas at Yinxu suggests that diverse segments of the population witnessed or participated in the performance of socially-sanctioned violence. Past research on violence in the Late Shang has not fully addressed the possible influence of these large-scale collective acts on small-scale interpersonal violence.

This project uses a bioarchaeological approach to compare osteological signatures of violence on human skeletal remains excavated from sacrificial and non-sacrificial contexts at the residential area of Liujiazhuang at Yinxu. Basic demographic profiles of Shang citizens and sacrificial victims are provided, followed by an analysis of the distribution and types of antemortem and perimortem traumatic lesions. The results of this analysis revealed gendered differences in trauma in formal burials and sacrificial contexts. This project demonstrates how bioarchaeological analyses can shed new light on our understanding of violence during the Late Shang.

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Species recognition in the hominin fossil record

BERNARD A. WOOD[1] and RICHARD J. SMITH[2]

[1]Center for the Advanced Study of Human Paleobiology, George Washington University, [2]Department of Anthropology, Washington University in St. Louis

There has been relatively little consideration of what researchers need to do to justify erecting a new hominin species. The fossil records of existing species, especially those based on modestly-sized site samples drawn from a relatively restricted region and time range, are unlikely to capture the actual range of temporal and spatial variation within that species. So, we should not assume that when new fossil evidence lies outside the variation envelope of existing species it necessarily samples a different, novel, species.

The key issue is distinguishing between the known variation in the available sample of the species as observed from the fossil record, and the estimated variation in the species as a population. The range of a modestly-sized sample is a much smaller biased estimate of the range of the parent population, but while statistics such as the mean and standard deviation have large confidence intervals, they are not biased. Before metric data are used to argue a feature is different than it is in samples of existing species, and therefore evidence for a new species, the size of the new specimens must be evaluated against some estimate of the species range, not just the known fossil specimen range. Because there will be considerable error in estimating the population range from the range of a small sample, we will discuss how far outside the existing variation envelope the new evidence has to be before it would be prudent to reject the hypothesis that it samples an existing species.

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Dental size reduction in tame Russian silver foxes and its implications for the 'self-domestication' model in hominin evolution

EMMA K. WOOD[1], SCOTT D. MADDUX[2], THOMAS E. SOUTHARD[3], ANASTASIYA KHARLAMOVA[4], LYUDMILA TRUT[3] and ROBERT G. FRANCISCUS[1,3]

[1]Department of Anthropology, University of Iowa, [2]Center for Anatomical Sciences, University of North Texas HSC, [3]Department of Orthodontics, University of Iowa, [4]Institute of Cytology and Genetics, SB RAS

Paleoanthropologists have long emphasized dental size reduction in hominin evolution. Reduced canine crown dimensions in humans are linked with greater male cooperative behavior compared to primates that exhibit high inter-male aggression. Moreover, arguments for 'self-domestication' in both early dogs and bonobos are based, in part, on empirical patterns of dental size reduction from ancestral forms. The Russian fox domestication experiment provides an untapped source for studying this evolutionary dynamic because it provides a controlled, long term study of selection for non-aggressive behavior and attendant morphological consequences. Yet, dental size variation among these experimental foxes has not been heretofore studied. We employed univariate and multivariate comparisons of maxillary P4, M1, and canine mesiodistal length, buccolingual breadth, and crown height of the canine, as well as mandibular M1 mesiodistal length and buccolingual breadth. These data were collected in sex-balanced samples of the unselected (n=50), tame (n=49), and aggressive (n=50) experimental strains. All measurements were taken directly on macerated, fully cleaned elements using Vernier calipers affording measurement accuracy to 0.05 mm. Consistent with expectations from the 'self-domestication' model, tame fox skulls exhibited statistically significantly reduced tooth dimensions in virtually all comparisons relative to both unselected and aggressive strain individuals. This result was most pronounced for the canine tooth measurements. These previously undocumented results in domesticated foxes parallel well-documented trends in dental size reduction in humans, dogs, and bonobos. Accordingly, these results appear to further support the self-domestication hypothesis, and highlight the utility of dental evidence as a morphological indicator of reduced aggression.

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Load at first bite: comparative analysis of incisor cross-sectional area in anthropoid primates

JACOB A. WOOD[1,3] and JEREMIAH E. SCOTT[2,3]

[1]Department of Biology, University of Indinapolis, [2]Department of Medical Anatomical Sciences, Western University of Health Sciences, [3]Department of Anthropology, Southern Illinois University Carbondale

Previous studies have established that frugivorous anthropoids have larger incisor dimensions relative to body mass than folivores. This distinction is often attributed to frugivores using their incisors more intensively during ingestion than folivores, but this assumption has been challenged. In this study, we tested the hypothesis that the ability of incisors to withstand loading varies according to diet. We divided a sample of 87 anthropoid species into three dietary categories: frugivores, folivores, and hard-object feeders (HOFs). Using mesiodistal and buccolingual diameters, we computed incisor cross-sectional areas (CSAs) and size-adjusted them by dividing their square roots by jaw length, a widely used standard in studies of masticatory biomechanics. Comparisons conducted using phylogenetic generalized least squares indicate that HOFs and frugivores tend to have larger CSAs relative to jaw length than folivores, but frugivores and HOFs cannot be distinguished. We also tested for differences between platyrrhines and catarrhines, as catarrhines have been characterized as having larger incisors than platyrrhines, regardless of diet. Such differences were only apparent in folivores: in this group, platyrrhines have significantly smaller incisor CSAs than catarrhines. Our results are consistent with the hypothesis that folivores tend to load their incisors less severely than other primates. We note, however, that the strength of this signal is exaggerated by the unusually small incisors of platyrrhine folivores; in catarrhines, overlap between folivores and other groups is extensive. Such overlap comports with data on tooth wear and ingestion behavior suggesting that some catarrhine folivores use their incisors as intensively as frugivores.

How do food material properties affect ingestive behavior?

KRISTIN A. WRIGHT[1], ANNE O. RIVERA[2], BARTH W. WRIGHT[3], MARIANA FOGAÇA[4], ADAM VAN CASTEREN[5], DOROTHY FRAGASZY[6], ROBERT S. SCOTT[7], DAVID S. STRAIT[8], CALLUM F. ROSS[9] and MYRA F. LAIRD[9]

[1]Department of Biomedical Sciences, University of Missouri-Kansas City, [2]Department of Anthropology, Northwestern University, [3]Department of Anatomy, Kansas City University of Medicine & Biosciences, [4]NeoPReGo, Neotropical Primates Research Group, [5]Max Planck Weizmann Center for Integrative Archaeology and Anthropology, Max Planck Institute for Evolutionary Anthropology, [6]Department of Psychology, University of Georgia, [7]Department of Anthropology, Rutgers University, [8]Department of Anthropology, Washington University, [9]Department of Organismal Biology and Anatomy, University of Chicago

Much attention has been paid to the role of masticatory biomechanics in driving the evolution of skull form in primates, including fossil hominins. The influence of ingestion and pre-ingestive behaviors on primate and human evolution is less well understood. We examined the relationships between food material properties (FMPs) and oral ingestive and pre-ingestive behaviors by examining how FMPs affect the placement of food in the mouth. Foods with hard and tough material properties were expected to be placed posterior to the lower canine. We predicted that FMPs would affect the number of chewing cycles, with tougher foods requiring an increase in the number of chewing cycles. Finally, we qualitatively related pre-ingestive behavior to FMPs and chewing cycles. These hypotheses were tested using approximately 30 hours of feeding behavior captured from wild bearded capuchin monkeys (*Sapajus libidinosus*). We extracted 900 observations of ingestive behavioral states, their durations, number of chewing cycles during mastication, and the use of the limbs during pre-ingestive behaviors. Discarded food items were collected and their elastic moduli and toughness were measured with the Lucas FLS-1 portable mechanical tester. Stress and displacement limited fragmentation indices were calculated from these measures. We found that pre-ingested tissues were both significantly tougher (5299 Jm^2 vs. 1389 Jm^2) and stiffer (10.7 GPa vs. 0.0031 GPa) on average than ingested tissues. Tougher tissues were subject to more chewing cycles per item and the use of the forelimbs and jaws together to breach food items prior to ingestion.

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Characterization of *MHC-DRB* immunogenetic diversity in the wild chimpanzees (*Pan troglodytes schweinfurthii*) of Gombe National Park, Tanzania

EMILY E. WROBLEWSKI[1], SARAH PHILLIPS-GARCIA[2], LISBETH GUETHLEIN[3] and PETER PARHAM[3]

[1]Anthropology, Washington University in St. Louis, [2]Anthropology, University of New Mexico, [3]Structural Biology, Stanford University School of Medicine

Genes within the vertebrate *Major Histocompatibility Complex* (*MHC*) are extremely polymorphic and rapidly evolving. They encode molecules essential to the immune response in recognizing and presenting antigens to T cells. The MHC class I and class II molecules participate in complementary pathways of pathogen detection, presenting peptide antigens originating within and outside the cell, respectively. Chimpanzees are an important comparative and model species for understanding the function of and selection on this gene complex in humans, however most research has been conducted in highly managed captive populations, predominated by the *Pan troglodytes verus* subspecies, which lacks SIVcpz infection in the wild. Following previous characterization of the most polymorphic *class I* gene (*Patr-B*) in the wild Gombe chimpanzees, naturally infected with SIVcpz, we analyzed the most variable *class II* gene, *Patr-DRB*, which is variable in both copy number and allele content. Using DNA isolated from feces of 125 chimpanzees from Gombe's three communities, we PCR amplified the polymorphic exon 2 of *Patr-DRB* and performed next-generation sequencing of the PCR products. Of the four genes that produce functional molecules (*DRB1*, *DRB3*, *DRB4*, and *DRB5*), all or nearly all (except three) animals possessed *Patr-DRB1* and *Patr-DRB3*, respectively. However, only 32.8% of chimpanzees (N=41) had *Patr-DRB4*, and only 23.2% (N=29) had a functional allele. Likewise, *Patr-DRB5* was only present in 44.8% (N=56) of chimpanzees. *Patr-DRB4* and *-DRB5* frequencies are within the range observed for their human homologs and did not differ between communities. Future work will test association of particular alleles with SIVcpz infection.

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Plantar pressure distribution during bipedalism in nonhuman primates

ROSHNA E. WUNDERLICH

Department of Biology, James Madison University

Specialization of the human foot has long been considered a hallmark of our bipedal gait. However, numerous primates use bipedalism either opportunistically or regularly within their locomotor repertoire, and little is known about foot use during nonhuman primate bipedalism. In this study plantar pressure distribution during bipedalism was compared across a wide range of primates in order to ask what aspects of bipedal foot function are fundamental to the mechanics of bipedal movement and what features are uniquely hominid or hominin and may be important to the evolution of the human foot. Plantar pressure distribution during bipedalism was collected in five *Propithecus*, two *Cebus*, one *Ateles*, and two *Pan* at the SBU primate locomotion laboratory and the Duke Lemur Center. Peak pressures and contact time were quantified in ten anatomical regions and compared between bipedal and quadrupedal gaits and across species. Considerable variation exists in nonhuman bipedalism and foot use. However,

across nonhuman primates, bipedal walking elicited lower toe 2-5 pressures and higher midfoot pressures than quadrupedalism as well as abducted and loaded halluces. A lateral-to-medial weight shift at the end of stance occurred in the anthropoids. *Pan* exhibits high medial midfoot loads because of their mobile midfoot and long contact times on the hindfoot and midfoot. *Pan* and humans share a heel strike with high peak pressures. The low medial midfoot pressures and high toe-off peak pressures are unique to humans and necessitate special features exhibited only in the hominin midfoot and forefoot.

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Can digitigrade hand postures be inferred from carpal morphology in extant and fossil cercopithecoids?

CRAIG WUTHRICH[1], LAURA M. MACLATCHY[2], MONTE L. MCCROSSIN[3] and BRENDA R. BENEFIT[3]

[1]Evolutionary Anthropology, Duke University, [2]Anthropology, University of Michigan, [3]Anthropology, New Mexico State University

Digitigrade hand postures are thought to have evolved independently in several lineages of extant, highly terrestrial cercopithecines. The ability to diagnose this hand posture in cercopithecoid fossil remains would be useful in understanding the clade's locomotor history, but features distinguishing digitigrady have been difficult to identify. Here we present analysis of metrics derived from 3D carpal models of 336 individuals from 28 anthropoid taxa. Models evaluating morphological covariance with digitigrady incorporate phylogeny and body size. Traits distinguishing digitigrade taxa from other anthropoids were found to contribute to discrete functional complexes within the carpus, including a distal mortise enhancing carpometacarpal joint stability and a narrow central column reflecting predominantly parasagittal limb movement during habitual locomotion, with additional features facilitating load transmission and stability at the midcarpal and antebrachiocarpal joints. Traits with statistical and plausible biomechanical links to digitigrady were used to construct a multivariate classifier, with accuracy exceeding 90% after repeated 10-fold cross-validation. When applied to a small fossil cercopithecoid sample, *Victoriapithecus macinnesi* is classified with high probability as palmigrade, consistent with previous reconstructions finding it to have maintained substantial reliance on arboreal substrates. *Theropithecus brumpti* demonstrates comparatively greater affinity with digitigrade cercopithecines; its capitate has a larger dorsal nonarticular region and more concave hamate facet, the distal facets of the capitate and lunate are narrower, and its stylo-triquetral articulation is larger. In other diagnostic features the fossil taxa do not differ, however. *T. brumpti* is classified as digitigrade with a low posterior probability, perhaps indicating incipiency of its terrestrial adaptations.

Nutrient intake across the dry season in *Lemur catta* sexes

NAYUTA YAMASHITA[1,2] and MARNI LAFLEUR[3]

[1]Institute of Population Genetics, University of Veterinary Medicine, Vienna, [2]Austrian Academy of Sciences, [3]Dept. Anthropology, University of California, San Diego

Lemur catta in dry forests have reproductive schedules that are synchronized to their highly seasonal environments. Accordingly, the sexes may have different energetic requirements related to the timing of their relative reproductive contributions. Females are expected to be energetically and nutritionally stressed for most of the year, but especially during late gestation and lactation. Males are expected to be most stressed during the mating season. In this study, we examine seasonality and sex differences in dietary chemical intake.

We followed two lemur troops in Tsimanampesotse National Park, southwestern Madagascar. We collected food plants for analyses of macronutrients, secondary compounds, calories, and metabolizable energy, then calculated intake (plant chemistry values factored by amount ingested) for each of these chemicals. Our study occurred over three time periods: the transition between wet and dry seasons (end lactation), beginning of the dry (mating), and toward the end of the dry (end gestation).

The chemicals in food plants did not change among the time periods examined. However, intake differed for some chemicals, and female intake was absolutely higher than that of males. Nutrient intake was a function of the quantity of a plant consumed, either through more time spent feeding or food size, rather than the amount of a chemical contained in a plant. A few plant species contributed the bulk of a particular nutrient at certain times. Our results show sex differences in nutrient intake that fluctuate throughout the dry season in contrast to relatively stable patterns of nutrient availability.

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Gibbon phylogeography using museum specimen DNA

LU YAO[1,2] and ROBERT DESALLE[2]

[1]Mammalogy, American Museum of Natural History, [2]Sackler Institute for Comparative Genomics, American Museum of Natural History

Gibbons are endangered and inadequately studied small apes and are species-rich compared to great apes. Their species-level phylogeny has been largely resolved, although certain discordances exist, perhaps because of hybridization between species. Our research draws upon wild gibbon specimens housed in museum collections around the world to expand knowledge about the phylogeography of gibbons and the suspected interspecific hybridization in Southeast Asia. We used next generation sequencing techniques to sequence the mitochondrial genomes and portions of the nuclear genome of 100 gibbon museum specimens. The reconstructed phylogeny traces the colonization of gibbons in Southeast Asia. We also show that like other primates in the region, there is a split in the groups living on the island of Sumatra, with white handed gibbons (*Hylobates* lar) occurring to the north and the mountain agile gibbon (*Hylobates agilis*) occurring to the south. Moreover, this research has applications for conservation biology. Most gibbon species are classified as "Endangered" or "Critically Endangered", yet conservation efforts are often focused on great apes rather on these small-bodied relatives. So targeted action is acutely needed to promote gibbon conservation, and one way to achieve this is to confirm taxon identity as a basis for appropriate recognition of individuals for reproduction in captivity with a view to subsequent reintroduction into their natural habitats.

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Scaling relationships of axonic patterning in the hands and feet of primates

GABRIEL S. YAPUNCICH[1,2] and DOUG M. BOYER[2]

[1]Molecular Biomedical Sciences, North Carolina State University, [2]Evolutionary Anthropology, Duke University

Primates exhibit two principal patterns of relative ray length in their hands and feet: mesaxony, in which the third digit is the longest, and ectaxony, in which the fourth ray is the longest. Manual ectaxony has been interpreted as indicating increased ulnar deviation during grasping. Assuming a similar mechanism, pedal ectaxony may indicate the use of habitually abducted foot postures. While relatively large diameter substrates may require greater foot abduction during clinging, the same effect should not be present for the hands, partly because the included angle of a bimanual grasp can be increased through lateral rotation at more proximal limb joints. Because small-bodied primates are more likely than large-bodied primates to encounter relatively large diameter supports, we predict that pedal axony will be correlated with body mass, but there should be no correlation between manual axony and body mass. Lengths of the metapodials, proximal and intermediate phalanges of the third and fourth digits were measured in strepsirrhines, platyrrhines, and tarsiers (n=34 taxa, 391 individuals). For hands and feet, the

scaling pattern of the ratio of the third to fourth rays relative to body mass were estimated using phylogenetic generalized least squares regressions. Manual axony was not significantly correlated with body mass, while pedal axony exhibited a significant positive correlation with body mass. These results are consistent with the inference that small-bodied primates encounter relatively large diameter vertical supports more frequently than larger primates, and increase the included angle of their grasp through elongation of the fourth pedal ray.

The Influence of Social Networks on Similarity of Gut Microbes in the Common Vampire Bat (*Desmodus rotundus*)

KARTHIK YARLAGADDA[1], AURA RAULO[2], SIMON RIPPERGER[3,4] and GERALD CARTER[4]

[1]Anthropology, University of Illinois Urbana-Champaign, [2]Zoology, Oxford University, [3]Ecology, Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Science, [4]Animal Behavior, Smithsonian Tropical Research Institute

Studies in primates have shown that social grooming and proximity are important factors in driving similarity in gut microbiomes between individuals. To investigate whether or not this pattern holds in other social animals, we turned to the common vampire bat, *Desmodus rotundus*. In addition to allogrooming by licking, the vampire bat demonstrates cooperative food sharing. Unsuccessful foragers can receive regurgitated blood from both kin and non-kin members of their society. We expected both social grooming and food sharing to increase gut microbiome similarity, even after controlling for maternal kinship. As obligate blood feeders, their diet is more uniform than most other mammals, reducing the confounding effect of diet.

We created the social grooming and food sharing networks using 15 hours of focal sampling for each of 33 captive vampire bats. We collected fecal samples, stored in ethanol, for DNA extractions. We then sequenced the V3-V5 region of the 16S rRNA of the samples on the Illumina Fluidigm platform. Analyses, including demultiplexing, quality trimming, and alignment were primarily conducted in QIIME2. Here, we present the first analysis of the gut microbiome in the common vampire bat, including a host of novel microbes. Our findings augment previous studies on the relationship between social animals and their gut microbes.

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Calculus and survivorship in medieval London: the association between dental disease and a demographic measure of general health

SAMANTHA L. YAUSSY and SHARON N. DEWITTE

Anthropology, University of South Carolina

Dental plaque, a biofilm containing millions of bacteria and their biproducts, is associated with a variety of systemic diseases and mortality risks in living populations. However, bioarchaeologists have not fully investigated the mortality risks associated with plaque (or its mineralized form, calculus) in the past. In this study, we examine the relationship between age at death and calculus in individuals from four sites in medieval London, *c.* 1000-1540 CE (Guildhall Yard, East Smithfield, St. Mary Graces, and St. Mary Spital) using binary logistic regression and Kaplan-Meier survival analysis. Age-at-death was estimated using the method of transition analysis, and data on the presence of dental calculus from the left mandibular molar was obtained from the Museum of London Wellcome Osteological Research Database (WORD). The regression results indicate that, among all sites and burial types, there is a significant negative relationship between age and calculus presence ($p < 0.001$). Similar results were obtained when the regression was limited to non-plague sites and burial types ($p < 0.001$). Survival analysis results indicate decreased survivorship among individuals with calculus compared to those without calculus, in both the full and non-plague samples ($p < 0.001$). These results suggest that individuals with dental calculus had significantly lower survivorship, compared to individuals without calculus. As in modern populations, calculus accumulation put the inhabitants of medieval London at greater risk of premature death. The evaluation of calculus in the context of a demographic measure of general health suggests that it might provide insights into health in past populations.

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Subadult age estimation of Taiwanese populations using long bone dimensions from radiographs

AN-DI YIM[1], KYRA E. STULL[2], HSIAO-LIN HWA[3] and HON-MAN LIU[4]

[1]Department of Anthropology, University of Illinois at Urbana-Champaign, [2]Department of Anthropology, University of Nevada, Reno, [3]Department and Graduate Institute of Forensic Medicine, College of Medicine, National Taiwan University, Taipei, Taiwan, [4]Department of Medical Imaging, National Taiwan University Hospital, Taipei, Taiwan

Age estimation from the skeletons in subadults is based on growth and development of the skeleton. Long bone length and width have been shown to have a strong positive correlation with age and therefore a good predictor of chronological age. However, populations will likely have different standards for age estimation because long bone dimensions are susceptible to environmental influences and lifestyle differences. Currently, most subadult ageing methods have not been tested in Asian populations and it is necessary to quantify the external validity and if necessary, develop population-specific standards.

This study analyzed 250 computed tomography scans of males and females between 1 and 15 years old from National Taiwan University Hospital. Measurements of diaphyseal and epiphyseal dimensions of humerus and femur were collected and multivariate adaptive regression splines were used to build models and construct prediction intervals for the sample. As age increases, the accuracy of the Stull et al. (2014) method decreases. Thus we built population specific models in order to capture the entirety of the variation in the Taiwanese sample. Similar to previous findings, single variable models with diaphyseal length generated the narrowest age prediction intervals for the youngest ages, but as age increased, the incorporation of additional variables was beneficial to prediction. The results of this study are consistent with previous studies on subadult age estimation but shed light on the potential of universal models for younger age periods and stress the need for population-specific standards for older age periods.

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A comparison of the cross-sectional area of the primate mandibular canal and associated foramina

CAITLIN B. YOAKUM and CLAIRE E. TERHUNE

Department of Anthropology, University of Arkansas

The trigeminal complex is critical for mastication because it provides sensory and motor information to most soft and hard tissues of the masticatory apparatus and face. However, few studies have explored the relationship between canal size, foramen size, and the soft tissues of this complex. Several studies have shown that infraorbital foramen cross-sectional area and maxillary mechanoreception reflect dietary preference in mammals, but the mental foramen and mandibular canal have largely been ignored. Foramina are often assumed to be equal in size to the soft tissues that pass through them, with both suggested to be related to the cross-sectional area of the corresponding nerve canal. No study has demonstrated the relationship between mental foramen and mandibular canal size, or their relationship to the soft tissues occupying these spaces. Using microCT data from 23 species of catarrhine male primates (n=42 specimens) we examined variation in cross-sectional

area of the mental foramen, mandibular canal, and mandibular foramen. Initial analysis revealed that canal size varies considerably and is not always definable as a single bony canal. Of those specimens where canal length could be defined (n=17), mental foramen area was ≤ 50% of mandibular foramen area. All variables were significantly correlated ($p<0.05$), with the mandibular canal to mandibular foramen correlation showing high significance ($p<0.001$). These findings call into question previous assumptions regarding the relationship between mental foramen area and the mandibular nerve. These preliminary data are critical for establishing a framework for future work examining the soft tissues running through the mandibular canal.

Mechanical analyses of leaping performance in Eastern gray squirrels (*Sciurus carolinensis*): implications for early primate locomotor evolution

JESSE W. YOUNG[1], THOMAS MAZONAS[1], ADRIENNE N. WOLFE[1], BRAD A. CHADWELL[2] and DOUG M. BOYER[3]

[1]Department of Anatomy and Neurobiology, Northeast Ohio Medical University, [2]Department of Anatomy, Idaho College of Osteopathic Medicine, [3]Department of Evolutionary Anthropology, Duke University

Recent analyses of fossil primate postcrania have emphasized the importance of leaping during early primate locomotor evolution. However, few *in-vivo* data exist with which to validate performance-related hypotheses arising from morphological studies. We present force platform data on the dynamics of leaping in squirrels (*Sciurus carolinensis*). As small-bodied, saltatory, arboreal rodents, squirrels represent a reasonable extant proxy for early euarchontans (e.g., plesiadapiforms). Two females (mass: 507-531g) were trained to vertically leap from a pair of force platforms (one beneath each foot). Force data from 87 trials were processed to calculate center of mass dynamics. Jump heights ranged from 20.2-78.0cm, equal to 81-315% of non-caudal body length. Vertical forces peaked at 473-647% of body weight (BW), and were considerably greater than the maximum forces measured during quadrupedal bounding in the same individuals (189-367% BW), suggesting that limb loading in leaping may exert a stronger influence on skeletal form. Peak mass-specific power output (135 Wkg^{-1}) was close to that of similarly-sized marmoset monkeys (118 Wkg^{-1}), greater than in larger primates (e.g., bonobo: 79 Wkg^{-1}; human: 49 Wkg^{-1}), but substantially lower than in bushbabies (797 Wkg^{-1}). Overall, our findings corroborate morphologically-based hypotheses that 1) basal primates likely exhibited some facility for acrobatic leaping (inasmuch as squirrels represent a reasonable extant proxy) and 2) leaping performance allometrically declines as body size increases across primates. Ongoing research aimed at collecting similar data from additional small-bodied primates will allow us to assess the degree to which certain primate-like morphological traits might aid leaping performance.

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The developmental genetics of the human scapula

MARIEL YOUNG[1], LYENA BIRKENSTOCK[1], NATHAN YOUNG[2], NEIL ROACH[1,3] and TERENCE D. CAPELLINI[1,4]

[1]Human Evolutionary Biology, Harvard University, [2]Orthopaedic Surgery, UCSF School of Medicine, [3]Division of Anthropology, American Museum of Natural History, [4]Epigenetics, Broad Institute of MIT and Harvard

Our previous research demonstrated that the hominin shoulder gradually evolved a more lateralized orientation from our last common ancestor with African apes, perhaps due to selective demands of high-speed throwing and tool use. This morphology is distinct from generalized ape scapular shape, which is adapted for stabilization and mobility during overhead use. These findings indicate that phenotypic differences in scapular shape between humans and African apes are generated at prenatal time-points. This suggests that the genetic targets of selection on scapular shape are developmental processes active during embryonic morphogenesis. However, little is currently known about mammalian scapular development in general, and even less about the specific genetic changes in humans that led to a lateralized shoulder configuration.

We use a mouse model to study chondrogenic stages of scapular development using functional genomic techniques: Assay for transposase-accessible chromatin (ATAC-seq) and RNA-sequencing. These assays were performed on dissected blade, neck, head, and acromial tissue from E15.5 embryos to identify genome-wide open chromatin profiles and differentially expressed mRNA transcripts associated with scapular components. We identify hundreds of open chromatin regulatory regions specific to individual scapular components, along with differentially expressed transcripts, near genes with known mouse and human pectoral girdle phenotypes. Using comparative genomics, we identify orthologous human regulatory regions and intersect these sequences with evidence of accelerated nucleotide evolution, indicative of positive selection in humans. We conclude by describing the complex functional testing, currently underway in mice, to better understand the influence of these targeted sequence changes on human scapular shape.

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Ecological niche models of human land use in Pleistocene Southeast Asia must account for both overall climate and environmentally specific variables

ALEXANDRA J. ZACHWIEJA and LAURA L. SHACKELFORD

Anthropology, University of Illinois Urbana-Champaign

Ecological niche models (ENM) have long been used to predict species distributions in the biological sciences. However, their use in paleoanthropological reconstructions of hominin niches is relatively recent and has focused largely on out of Africa dispersals and human occupation in Europe and Central Asia. These studies have shown that the most important variables to predict human land use are moderate temperature, rainfall, and access to fresh water. We apply these predictors to both mainland and island Southeast Asian landscapes during the harsh climate fluctuations of the Last Glacial Maximum (LGM). We validate our ENM using known fossil human occupation sites (n=20) to construct potential human land use maps in an area where glacial climate likely influenced human diet, mobility within habitats, and dispersal to new environments. We compare human land-use outputs from two popular ENM programs, Genetic Algorithm for Rule-Set Production (GARP) and Maximum Entropy Modeling (MaxEnt), to determine which program is more beneficial for studying human land use and dispersal across time and geography. Using only these parameters, both models suggest much of Southeast Asia was amenable to human use during the LGM. However, other environmental variables, particularly vegetation type, are likely necessary to fully understand past human land use. Rainforest environments have been considered patchier food sources than savannah environments in modern populations, and both environments were widespread in this time and place. We suggest further analysis accounting for additional environmental variables is necessary to gain a full understanding of human land use in Pleistocene Southeast Asia.

Geometric morphometrics of the neonatal thorax in prosimians

SARAH M. ZALESKI[1], TIMOTHY D. SMITH[2,3] and VALERIE B. DELEON[1]

[1]Department of Anthropology, University of Florida, [2]School of Physical Therapy, Slippery Rock University, [3]Department of Anthropology, University of Pittsburgh

Previous research has demonstrated thoracic morphological differences between adult orthograde and non-orthograde primates. This study analyzes thoracic CT data of cadaveric prosimians for the effect of posture mode on thoracic shape among neonates. The sample includes five specimens representing orthograde

species: *Galago senegalensis*, *Galago moholi*, *Propithecus coquereli*, *Hapalemur griseus*, and *Tarsius syrichta*. Antipronograde *Loris tardigradus* and pronograde *Otolemur crassicaudatus*, *Cheirogaleus medius*, *Lemur catta*, and *Eulemur mongoz* represent non-orthograde species. Two trials of thirty-five fixed 3D landmark coordinates and twenty-eight sliding semilandmarks representing the thorax were collected using Amira software and analyzed in the R Geomorph package. Measurement error analyses indicate an average fixed landmark precision of 0.0548mm and significant repeatability across specimens (nested ANOVA, $p<0.0001$). Principal components analysis (PCA) of symmetrized thoraces suggests both phylogenetic and posture mode effects on neonatal thoracic shape. Lemurids cluster closer than expectations based on posture differences, indicating a possible phylogenetic influence. Specimens separate significantly by posture mode along PC2 (Kruskal-Wallis, $p=0.0283$). Non-orthograde specimens exhibit a dorsoventrally deep thorax that is mediolaterally narrow and craniocaudally long with transversely-oriented ribs. Orthograde specimens exhibit a mediolaterally broad thorax that is dorsoventrally shallow and craniocaudally short. The vertebral column is more ventrally placed within the rib cage, and the ribs are caudally oblique. This study suggests that thoracic shape differences exist between posture groups at the neonatal stage.

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Climate Change Across African Protected Areas and its Implications for Primate Biodiversity

ANDREW J. ZAMORA and JASON M. KAMILAR

Anthropology, University of Massachusetts - Amherst

Climate models predict differing degrees of climatic shifts across the globe throughout the 21st century. These projections result in varying levels of climate change within contemporary protected areas. Protected areas have been found to be essential for maintaining and sometimes increasing population sizes of many tropical animals. Therefore, understanding how climate change could impact protected areas and their fauna is critically important. We examined the degree of climate change predicted across 135 mainland African protected areas for the years 2050 and 2070. We further examined how climate shifts are associated with five measures of primate community phylogenetic and functional diversity. We focused on primate communities as a test case due to their high species richness and biomass across Africa. We found that the degree of climate change associated with African protected areas varies across spatial scales, climate models, and different emissions scenarios. Overall, more species-rich communities are predicted to be exposed to significantly greater climate change. Significant relationships with other community metrics become more common toward 2070 and at higher emissions scenarios. We focus our discussion on a set of specific climate variables as illustrative examples of our findings and potential protected areas of special interest. Our results underscore the need for understanding projected climate effects and implementing appropriate precautionary measures across protected areas in light of their important roles in species/population management and biodiversity. We further suggest that examining climate projections and community metrics along with other anthropogenic factors could better facilitate establishing conservation priorities.

Diet and Disease in Medieval Berlin: Dental Pathology Data from the Medieval Cemetery of Petriplatz

MARIANA ZECHINI[1], KRISTINA KILLGROVE[1], CLAUDIA M. MELISCH[2], NATASHA POWERS[3] and BETTINA JUNGKLAUS[2]

[1]Department of Anthropology, University of West Florida, [2]Museum fur Vor-und-Frühghgeschichte, Museum fur Vor-und-Frühghgeschichte, [3]Allen Archaeology Ltd., Allen Archaeology Ltd.

Little is known about medieval Berlin due to a lack of surviving documents. This research focuses on the results of a dental pathology study of 64 individuals from the Medieval cemetery of Petriplatz and potential correlations with previously collected isotope data to better understand diet and disease in Berlin before and after the Black Death.

Our previously reported $\delta^{13}C$ and $\delta^{15}N$ isotope data suggested that people were eating a combination of C_3 foodstuffs, animal protein, and some freshwater fish before the Black Death. Afterwards, there was likely an increase in consumption of animal protein as suggested by higher $\delta^{15}N$ signatures. Because both stable isotopes and dental pathologies are seen as a proxy for diet, we collected further data from these skeletons, in the form of frequencies of carious lesions and dental calculus.

Of the 1,156 teeth examined, 44 had at least one carious lesion, with a TPR of 3.8%, which is surprisingly low considering their reliance on agriculture. Further, 527 teeth exhibited calculus (TPR 45.5%). As excess consumption of protein can lead to the development of calculus, we compared the $\delta^{15}N$ data with individual calculus frequencies; the Pearson r (0.2739), however, did not show a significant, positive relationship.

Dental pathology data from Medieval Petriplatz, Berlin, both lend support to and call into question interpretations drawn from stable isotope data. Further work will seek better ways to correlate these data, in order to better understand the diet and lifestyles of the earliest Berliners.

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Center of mass movements and energy recovery during arm-swinging in atelines

ANGEL ZEININGER[1], DANIEL SCHMITT[1], MICHAEL D. ROSE[1] and JEAN E. TURNQUIST[2]

[1]Department of Evolutionary Anthropology, Duke University, [2]Department of Anatomy and Caribbean Primate Research Center, University of Puerto Rico

Arm-swinging is a dramatic form of primate locomotion. In its most specialized form, practiced by hylobatids, the body moves in a pendular fashion. Potential and kinetic energy are exchanged, and energy loss due to vertical redirection of the whole body center of mass (bCOM collision) is minimized. Atelines also arm-swing but show different kinematic and muscle recruitment patterns from gibbons and use their prehensile tail during arm-swing. However, energy exchange in relation to anatomy and mechanics in atelines is unknown. Both *Ateles* and *Lagothrix* arm-swing, but the former rotates its body and restricts its motion to a sagittal plane to a greater degree than the latter. This study quantifies three-dimensional bCOM movements, step-to-step transition patterns, and energy recovery in two *Ateles fusciceps* and two *Lagothrix lagothricha* using tri-planar video recordings during arm-swinging along a continuous horizontal pole. In *Ateles*, elbow extension in the support arm allows the bCOM to swing vertically through a wide arc. During double-hand contact in *Ateles*, elbow flexion in the trailing arm and shortening of the effective length of the tail result in redirection of the bCOM backward and upward, thereby increasing potential energy available for the next swing and energy recovery. In *Lagothrix*, use of the tail with every hand-hold causes the bCOM to travel through a shallower vertical arc, thereby reducing energy recovery. These results suggest that primates adopt different strategies to solve mechanical demands associated with arm-swinging and that these strategies are constrained by morphological differences between these closely related species.

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The Medieval Mouth: Interpreting Oral Health in European Populations

KATIE ZEJDLIK[1], JONATHAN D. BETHARD[2], ZSOLT NYÁRÁDI[3] and ANDRE GONCIAR[4]

[1]Anthropology and Sociology, Western Carolina University, [2]Anthropology, University of South Florida, [3]Archaeology, Haáz Rezső Museum, [4]Archaeology, ArchaeoTek-Canada

Accurate assessment of dental health in archaeologically derived skeletal assemblages is challenging. The lack of soft tissue and patient history results in generalized etiologies, which can lead to over-interpretation of population health. To demonstrate this, a literature review of medieval health in European populations was performed to identify trends in interpretation as well as to demonstrate how our on-going work in the Székely region of Transylvania fits with others. Next, 67 individuals recovered from a medieval Székely cemetery were analyzed for age, sex, and dental health as indicated by calculus, caries, and abscesses. Burial position within the church suggests that individuals of high social standing were interred near the front of the church, while others were placed further away in the church yard or outside the yard wall; therefore, individuals from these three locations were included in analysis. Using burial location as an indicator of status, results show that frequency of dental caries and amount of calculus did not differ across burial location. Frequency of abscesses were slightly higher among individuals interred outside of the church. When examined on a smaller scale it is thought that individual access to resources and lifestyle need to be considered in interpretation of etiology of pathological modification of teeth. This is illustrated by the remains of a nobleman who presented with two abscesses that may have been the result of trauma to the tooth rather than diet as often assumed when interpreting dental health.

Morphological Variation in the Distal Humerus of Modern Humans, Apes and Fossil Hominins

KAYA G. ZELAZNY, ADAM D. SYLVESTER and CHRISTOPHER B. RUFF

Center for Functional Anatomy and Evolution, Johns Hopkins School of Medicine

While early descriptions of fossil hominin distal humeri remarked on their human-like qualities and found few features of taxonomic significance, more recent studies have identified morphological characteristics that distinguish different early hominin taxa from both modern humans and apes. However, most previous studies are constrained to two dimensions, and none include a comprehensive modern human comparative sample. This study uses 3-D morphometrics to compare seven human populations (total N=256) with samples of *Pan* (N=56), *Gorilla* (N=52) and *Pongo* (N=26) to assess more accurately extant ranges of variation in humeral morphology. Seven fossil hominin humeri (A.L. 288-1, KP 271, KNM-ER 739, KNM-ER 1504, SKX 24600, STW 431, TM 1517) are compared to these distributions.

In our first set of analyses, we placed 30 fixed landmarks covering the entire distal humerus. Subsequently, we isolated a subset of 21 articular landmarks. Generalized Procrustes and principal component analyses were run separately on each of these landmark sets. Modern humans and apes were almost completely separable in both sets. Differences in the 30-landmark analysis are driven by periarticular features, especially the position of the epicondyles, while differences in the articular analysis are driven by articular relief and posterior trochlear development. Fossil specimens group with humans in the full-morphology analyses, with no apparent taxonomic or temporal trends. However, in the isolated articular analyses earlier australopiths are notably more ape-like than later taxa, demonstrating a temporal trend. Our results indicate that phylogeny and function have different effects on the articular and periarticular regions of the distal humerus.

Stature estimation from post-mortem CT femoral measurements in contemporary Danish population

QUN ZHANG[1,2], MARIE LOUISE JØRKOV[2], CHIARA VILLA[2] and NIELS LYNNERUP[2]

[1]Department of Archaeology, Jilin University, [2]Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen

Stature estimation methods for adult in Danish population have generally relied on Trotter and Glesers and Boldsen's regression equations that are based on Korean War dead American Whites and Danish archaeological medieval skeletal materials, respectively. These formulae are probably not suitable for estimating the stature in present day Danish forensic cases. Furthermore, since post-mortem computed tomography (PMCT) is now carried out routinely at the Danish forensic departments, formulae based on PMCT are needed, rather than measurements of defleshed bones.

The aim of this study is to develop the optimal formulae for stature estimation in Danish forensic cases on PMCT femoral measurements. Maximum femoral length was measured on 90 Danish PMCT (48 males and 42 females) from 23 to 45 years old. The accuracy of measure on PMCT image was tested on dry bones and all the measurements were included in inter- and intra-observer analyses. Stature estimation was also done using the equations after Trotter and Gleser (1952) and Boldsen (1990) for comparison.

New regression equations were developed and validated on a different sample of 20 Danish forensic cases. Comparisons of formulae indicated that both the previous ones underestimated the stature. The new formula developed in this study provides a reliable alternative for modern Danish forensic cases.

The sample used in this study are part of the Danish project "SURVIVE: Let the dead help the living".

Violence and Conflicts in the Eurasian Steppes: A Study on Cranial Trauma Among Three Bronze-Iron Age Populations from Turpan Depression, China

WENXIN ZHANG, YEZHOU XIONG, SHIYU YANG, ANQI WANG, XINGYU MAN, XUEZHU LIAO and XIAOFANG GAO

Department of Archaeology, Jilin University

This paper presents a study on the violence-related cranial trauma from three cemeteries in Turpan Depression, which is located in northwest China. By analyzing the shape, pattern, direction and formation mechanism, we aim to reconstruct the conflicts between ancient populations in the Eurasian Steppes.

145 skulls from three Bronze-Iron age cemeteries, Shengjingdian (29), Yanghai (53) and Jiayi (63) were examined. Trauma types were divided into three patterns: blunt force trauma, sharp force trauma and penetrating trauma. Characteristics of trauma on each skull were recorded in detail.

Results suggest that Jiayi population has a high frequency of skull trauma, with 33 individuals (52.38%) and 56 injuries. In comparison, Yanghai (8 individuals, 15.09%, 14 injuries) and Shengjindian population (3 individuals, 10.34%, 6 injuries) have a much lower frequency. penetrating trauma is much more common (60.87%) than the other two patterns. Most injuries occurred on cranium (94.81%) rather than the facial cranium. There is no significant difference between males and females, while the bilateral difference is unapparent either.

The results obtained from our study indicate that violence and conflicts did exist in Turpan Depression during Bronze-Iron age, especially in Jiayi population. As 33.33% individuals suffered more than 1 injuries on their skulls, 39.29% injuries are lethal, Jiayi people is likely to have experienced some bloody combats against other populations, or several small conflicts among themselves. Finally, we expect further researches to provide more evidences, thus help to reconstruct the scene of fighting which happened in the Eurasian Steppes 2000-3000 years ago.

Effects of Body Size and Sex on Prehensile Tail Use in Mantled Howler Monkeys (*Alouatta palliata*)

KIMBERLY T. ZHU

Anthropology, University of California Santa Cruz

The mass bearing limitations of prehensile tails have been well studied in primatology. However, these studies have been primarily focused on osteological and musculoskeletal frameworks. This study contributes to existing literature by investigating the behavioral effects of this prehensile tail limitation in *Alouatta palliata*, commonly known as the mantled howler monkey. Observational data was collected through One-Zero sampling,

and analyzed to determine whether sex or body size affected rates of prehensile tail use in suspensory, locomotive, and stationary behaviors. Tail use in all three behavioral categories displayed a negative correlation with body size, while sex-based behavioral deviation was only strongly evidenced in suspensory behaviors within the small adult size class. The results from this study provide novel behavioral evidence for a mass-bearing threshold of prehensile tails, and support previous musculoskeletal and biological analyses of this concept in *Alouatta palliata*.

Reconstructing Australopith Bodies

ADRIENNE L. ZIHLMAN[1], CAROL E. UNDERWOOD[1] and DEBRA R. BOLTER[2]

[1]Anthropology, University of California, Santa Cruz, [2]Evolutionary Studies Institute, University of Witwatersrand, Johannesburg

Australopith postcranial skeletal remains are numerous and morphologically distinct from *Pan* or *Homo*, although fossil limb and pelvic bones share fundamental bipedal adaptations across East and South African species. Using australopith fossils AL 288 and Sts 14, we add a comparative dataset that allows functional reconstructions of australopith body mass, weights of limbs, and mass distribution among select muscle groups. We incorporate unique dissection data on *Pan paniscus* (n=13) with published and unpublished data on *Homo sapiens,* to document similarities and distinctions, and to model australopith soft tissues.

Pan upper limbs (15-18%) relative to total body mass are notably more massive than those of modern humans (8-9%). Australopiths with shorter upper limb lengths (AL 288) probably fall between 10-12%. Lower limb mass is similar in *Pan* (20-28%) and *Homo* (25-30+%); therefore australopiths fall within this range. However, in functional muscle groups acting on the lower limbs, we estimate australopith *gluteus maximus* heavier than *g. medius*. This is concordant with the shift in pelvic morphology for bipedalism, approaching the 2:1 value in *H. sapiens,* whereas in *Pan, g. medius* is equal to or heavier than *g. maximus.* In contrast, the ratios of quadriceps to hamstrings are similar in *Pan* and *H. sapiens,* both around 65/35, and australopiths are probably similarly proportioned, although with restructured attachment points. These data provide a working model for the reconstruction of soft tissue evolution in australopiths.

Gene expression in the primary visual cortex differs amongst phenotypically distinct primates

TRISHA M. ZINTEL[1], JOHN J. ELY[2], MARY ANN RAGHANTI[3], WILLIAM D. HOPKINS[4,5], PATRICK R. HOF[6,7], CHET C. SHERWOOD[8], JASON M. KAMILAR[10,9], AMY L. BAUERNFEIND[11,12] and COURTNEY C. BABBITT[1]

[1]Biology, University of Massachusetts Amherst, [2]Alamogordo Primate Facility, Holloman Air Force Base, [3]Department of Anthropology, Kent State University, [4]Neuroscience Institute and Language Research Center, Georgia State University, [5]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center, [6]Fishberg Department of Neuroscience and Friedman Brain Institute, Icahn School of Medicine at Mount Sinai, [7]New York Consortium in Evolutionary Primatology, [8]Department of Anthropology and Center for the Advanced Study of Human Paleobiology, The George Washington University, [9]Department of Anthropology, University of Massachusetts Amherst, [10]Organismic and Evolutionary Biology Graduate Program, University of Massachusetts Amherst, [11]Department of Neuroscience, Washington University School of Medicine, [12]Department of Anthropology, Washington University in St. Louis

Primates differ in how species visually perceive their environments. Although it is well established that primates display diversity in color vision and visual acuity, it is not understood how brain gene expression levels may be associated with differences in the visual system among primates. Examining the pattern of differences in gene expression in the primary visual cortex (V1) can provide insight into the evolution of visual adaptations in primates. We investigated the link between variation in gene expression and visual system traits across primates using RNA-Seq on mRNA extracted from V1 of 13 primate species. We explored trait-dependent differential expression by contrasting groups of species with differing visual system phenotypes and ecological traits. Differential expression (DE) was detected at more than 11% in primates differing in color vision (trichromatic vs polymorphic di/trichromatic), habitat-use (arboreal vs terrestrial), and group size. Categorical enrichment of differentially expressed genes determined that processes related to synaptic signaling and metabolism differ in the V1 of primates, with specific enrichment varying depending on the species or trait compared. In our analyses of differential expression in V1, we found the most marked difference between humans and chimpanzees compared to any other pair of species. In addition, a subset of these genes was under selective pressure. Our results demonstrate species-specific and trait-dependent differences in gene expression in the visual cortex and putative selective pressures influencing DE in the human lineage.

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Interpreting Prehistoric Spinal Health via Analysis of Schmorl's Nodes at Turkey Creek Pueblo in Point of Pines Region, Arizona

CAROLINE L. ZNACHKO

Anthropology, Texas State University

Schmorl's Nodes (SNs) have traditionally been utilized as a marker of antemortem work-related back injuries in both prehistoric and modern populations. Despite modern ergonomic interventions in the United States, rates of disc degenerative related disorders and resulting SNs have risen. In order to better understand the etiology of SNs and improve bioarchaeological models of interpretation, this study compares SNs among individuals at Turkey Creek Pueblo to the forensic, clinical, and medieval skeletal samples assessed by Dar et al. (2009), Faccia et al. (2007), and Plomp et al. (2012) respectively. Data collected includes: location, region, aspect, width and depth of SNs, presence and severity of osteophytes, and estimated age and sex. It was hypothesized that if the Turkey Creek Pueblo sample exhibited similar trends with the comparative samples, despite differing behavioral and environmental influences, then alternative etiologies could be considered beside the injury mode of interpretation. Data indicated a higher prevalence among males, a higher occurrence of inferiorly and centrally located SNs, increasing severity around the thoracolumbar junction, and similar trends among all samples. Results from modern clinical studies on the likelihood of pain-inducing SNs imply that 40.98% of the observed cases of SNs at Turkey Creek Pueblo likely resulted in back pain, for a total of 21.15% of individuals in the sample likely experiencing back pain as the result of SNs. The findings of this study can be used by bioarchaeologists to improve their interpretations of spinal health based on SNs and overall quality of life in past populations.

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Putting theory into practice: biocultural reconstructions of gender and social identity relative to health and disease in past populations

MOLLY K. ZUCKERMAN

Department of Anthropology and Middle Eastern Cultures, Mississippi State University

Despite its many interpretive merits, the biocultural approach can also simultaneously generate theoretical, epistemological, and methodological complications. In part, this is because of the difficulty of operationalizing complex, contingent, and multi-dimensional variables, like class; the multiple causal pathways that can generate biological and cultural outcomes, like sickness; and the degree of contextual information needed

for accurate and meaningful analysis. Here, I dissect and unpack the methods employed and the findings generated from analysis of a complex, biocultural, and political-economic research question—whether the use of mercury treatments for acquired syphilis (e.g., the "pox") vary relative to socio-economic status, sex, and by extrapolation, gender, in post-medieval England—to demonstrate methodological pathways for translating theory into bioarchaeological practice. Syphilis generates multiple interpretive and methodological issues for historical and skeletal evidence because of its intense stigma and the low specificity and sensitivity of its lesions. Post-medieval England was characterized by substantial shifts in gender roles and identity, complicating the reconstruction of gender, and substantial social mobility, complicating the reconstruction of socioeconomic status over the life course. These factors both explicate and complicate the finding of no significant relationships ($p<.05$) between mercury levels (from pXRF analysis of cortical bone), and estimated sex and status in skeletons with syphilis lesions across assemblages (N=22). When anchored in an empirical framework and approached from a biocultural lens, such a finding—which contradicts the historical evidence—can become a grounding point for practical explorations of biases and incongruities between evidence types and a source for novel research questions.