

Program of the 81st Annual Meeting of the American Association of Physical Anthropologists

To be held at the

Hilton Portland & Executive Tower

921 SW Sixth Avenue
Portland, Oregon 97204

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Local Arrangements Committee

John Lukacs (University of Oregon) and J. Josh Snodgrass (University of Oregon), Co-Chairs

Tara Cepon (University of Oregon)
Stephen Frost (University of Oregon)
Ed Hagen (Washington State University, Vancouver)
Greg Nelson (University of Oregon)
Bob Pastor (University of Oregon)
Larry Sugiyama (University of Oregon)
Frances White (University of Oregon)

Message from Program Committee Chair

Dear Attendees of the AAPA and Concurrent Conferences:

It is a pleasure to welcome you to our 2012 conference. With the support of my excellent assistant, the program committee has put together an exciting program including 1022 presentations (343 presented from the podium and 679 as posters). We tried to accommodate authors' preferences concerning presentation medium as much as possible while maintaining the AAPA custom of no more than four concurrent podium sessions. We also gave priority to scientific cohesiveness of sessions, so that papers on similar topics were put in the same session.

The original online registration and abstract submission system was developed by Ed Hagen and Phil Walker for the 2001 meeting. The internet has changed dramatically since then, and it was time to develop a new system based on the technologies that have emerged over the last 10 years. This year we launched a new abstract submission and data base system for generating the program. Designed and written by Ed Hagen, it dramatically decreased the amount of labor that goes into the process of reviewing abstracts and producing the program. As the new system evolves, we hope to provide a searchable, electronic version of the program that conference-goers can access on their laptops and smart phones.

The AAPA meetings start with the undergraduate poster symposium and our reception on Wednesday night, and end with the student awards reception on Saturday evening. As last year, the posters in contributed sessions will remain on display for an entire day (8 am to 4 pm), and the poster authors are expected to be present for discussion once in the morning and once in the afternoon. Contributed poster sessions will be held on the Plaza Level. We hope that the Plaza Level will be a good space for people to meet, talk, and socialize. Invited poster symposia (which meet either from 8-11 am or 2-5 pm) will be held in smaller rooms where interaction among the participants and audience will be facilitated.

As usual, we are meeting with other associations, namely the Paleopathology Association, the Human Biology

Association, and the American Association of Anthropological Genetics. I am very pleased about the jointly sponsored symposia with the latter two, namely **"Not by Bread Alone: Non-Caloric Determinants of Life History Strategies,"** organized by Virginia J. Vitzthum and Pablo Nepomnaschy and co-sponsored by the Human Biology Association and **"Innovation, Challenges, and New Directions in Genetic Research with Indigenous Populations,"** organized by Deborah A. Bolnick, and co-sponsored by the American Association of Anthropological Genetics. Another special session is the Wiley-Blackwell symposium, titled **"Language Origins and Pre-Modern Europeans: New Ways of Approaching an Old Problem,"** organized by David W. Frayer and Marina Lozano.

The Plenary Session this year is organized by John Hawks and is called **"Bringing Fossil Casts into the Open."** In the spirit of openness and sharing of data, we invite AAPA members to bring together casts and electronic materials to share and to stimulate lively conversation and discussion.

I would like to thank John Lukacs and Josh Snodgrass, the local arrangements co-chairs, for an excellent job in organizing the meeting. Working with them has been fun!. Ed Hagen has been amazing, continuing to tinker with the online registration and abstract submission system throughout the process of program creation. In addition, I thank my program committee, who reviewed a very large number of abstracts on a very tight schedule. Finally, I am profoundly grateful for the help of my heroic program assistant, Nedda Moqtaderi, who worked on the program up until a few hours before the birth of her daughter, Nora, as well as Kathy Dettwyler and Tom Rocek who provided emergency help whenever I needed it.

See you in Portland! I am looking forward to this exciting AAPA meeting.

Karen Rosenberg
AAPA Vice President and
Program Committee Chair

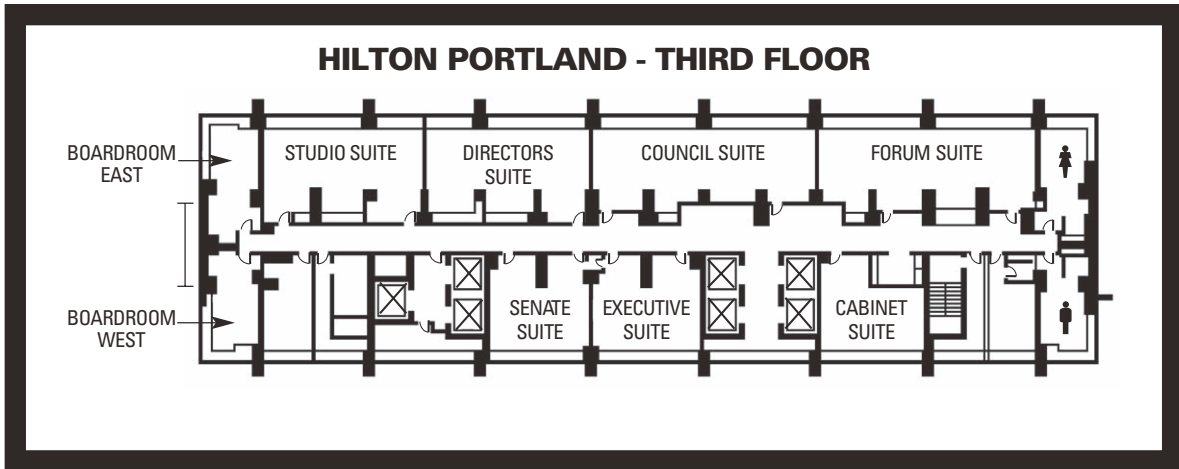
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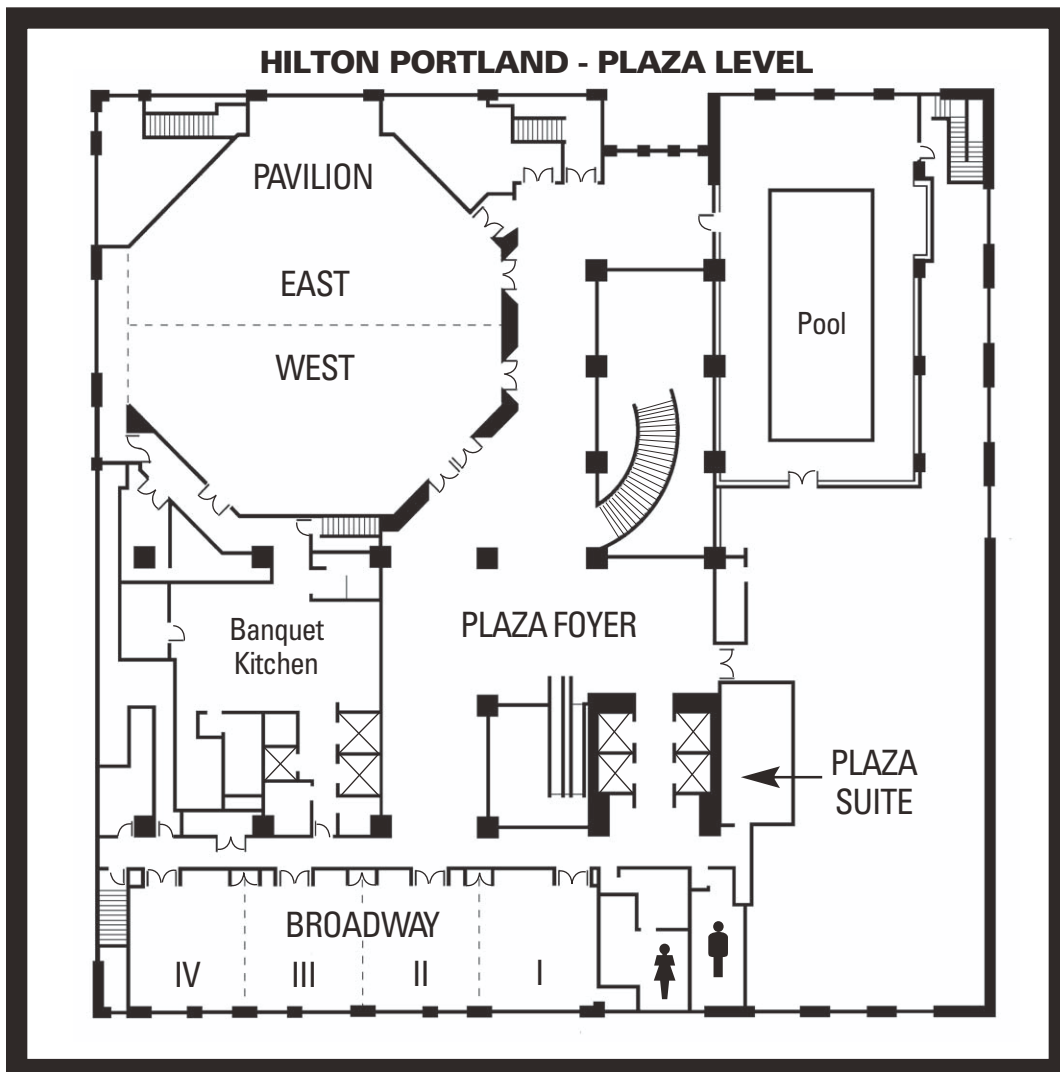
On the cover: The City of Portland, Oregon with Mount Hood in the background. Photograph courtesy of the Portland Chamber of Commerce.

Supplement 54 was mailed the week of February 27

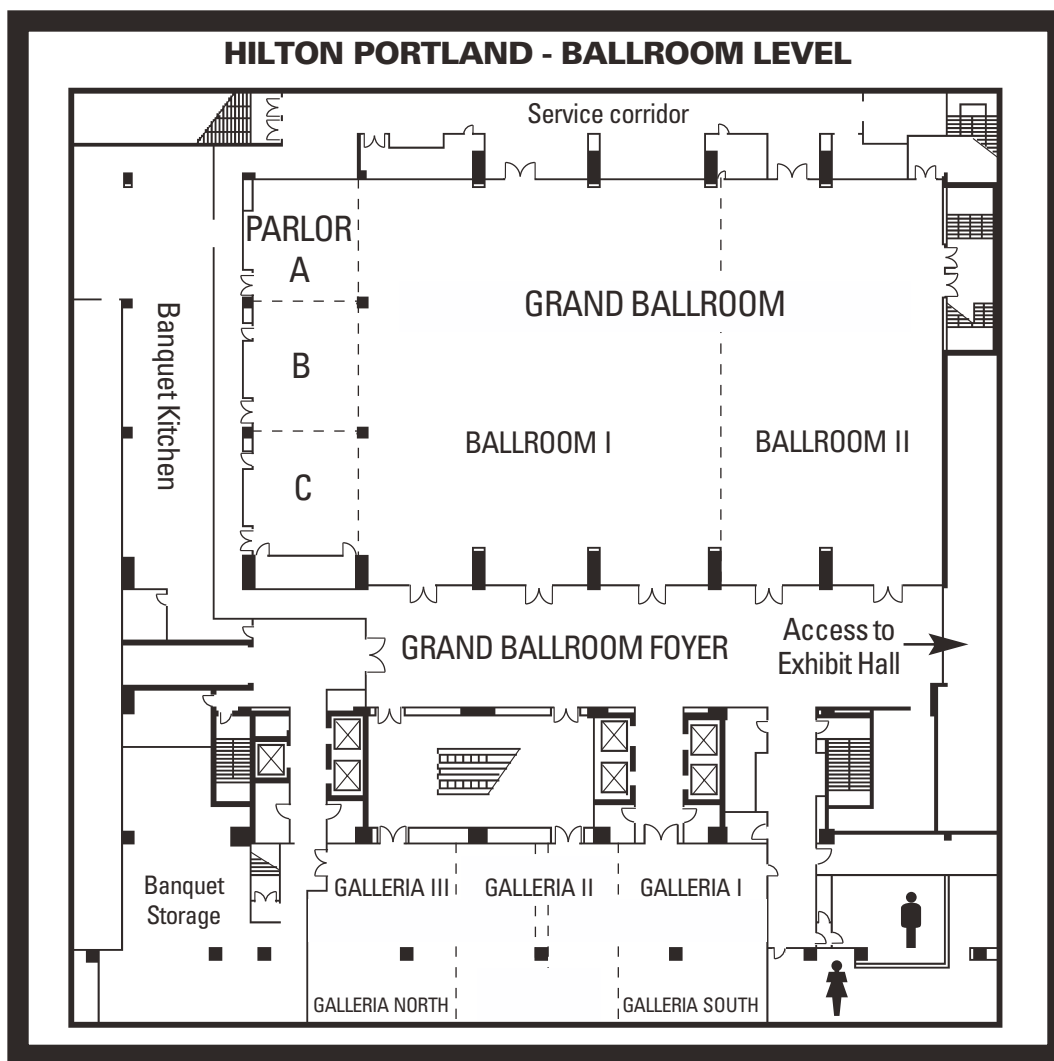
Floor Plan 1



Floor Plan 2



Floor Plan 3



Monday & Tuesday

Room	Monday am/pm April 9	Tuesday am April 10	Tuesday pm April 10		Tuesday evening April 10
Plaza Foyer	PPA Registration 6-9pm	PPA Registration 8am-5pm			HBA Registration 5-8pm
Pavilion Ballroom East		PPA Workshop 8am-12pm	PPA Podium 2-5pm	PPA Student Meeting 5:15-6:15pm	
Pavilion Ballroom West					PPA Dinner 6:30-10pm
Cabinet Suite		Speaker Ready Room			
Senate Suite		Press Room			
Executive Suite		Job Interview Room			
Directors Suite					HBA Executive Committee 6-10pm

KEY TO ACRONYMS:

<p> AAAG – American Association of Anthropological Genetics AAPA – American Association of Physical Anthropologists ADA – American Dermatoglyphics Association AJHB – <i>American Journal of Human Biology</i> AJPA – <i>American Journal of Physical Anthropology</i> BANDIT – Biological Anthropology Developing Investigators Troop DAA – Dental Anthropology Association EVAN – European Virtual Anthropology Network HB – <i>Human Biology</i> HBA – Human Biology Association JHE – <i>Journal of Human Evolution</i> PAWMN – Physical Anthropology Women’s Mentoring Network PPA – Paleopathology Association </p>
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Wednesday

Room	Wednesday am	Wednesday pm		Wednesday evening
Plaza Foyer	PPA Registration 8am-12pm HBA Registration 8am-5pm			
Pavilion Ballroom East	PPA Podium 8am-12pm	PPA Podium 2-5:30pm	PPA Student Awards 5:30-6:30pm	
Pavilion Ballroom West	PPA Poster Session 8am-5pm			
Broadway I	HBA Poster Session 8am-12pm			Undergraduate Research Symposium 6-8pm
Broadway II				
Broadway III				
Broadway IV				
Grand Ballroom Foyer				AAPA Registration 5-9pm
Grand Ballroom I				AAPA Welcome Reception 8-11pm
Grand Ballroom II		HBA Plenary/Podium 1-6pm		
Galleria North	EVAN Toolbox Workshop 8am-5pm			
Parlor C	AAPA Executive Committee Meeting 7:30am-6pm			
Cabinet Suite	Speaker Ready Room			
Senate Suite	Press Room			
Executive Suite	Job Interview Room			
Forum Suite	AJHB Breakfast 7:30-9am	AJPA Editorial Board Lunch 12-1:30pm		
Alexander's (23rd Floor)				

Thursday

Room	Thursday am	Thursday pm	Thursday evening
Plaza Foyer	Contributed Posters (8am-4pm) Session 1: Human & Nonhuman Population & Phylogenetic Studies (1-22). Session 2: Human Osteology/Bioarchaeology (23-116). Session 3: Human Osteology & Forensic Anthropology (117-153).		
Pavilion Ballroom East	Exhibitors 8am-4pm		
Pavilion Ballroom West	AAPA Posters (see above) 8am-4pm		
Broadway I	AAPA Posters (see above) 8am-4pm		Ethics Forum 6-8pm
Broadway II			Teaching Biological Anthropology in the 21st Century 6-8 pm
Broadway III	Session 6: Dental Anthropology. Contributed Podium Presentations. 8am-12pm	Session 11: Primate Evolution. Contributed Podium Presentations. 1-5pm	Race and Representation 6-8pm
Broadway IV			
Grand Ballroom Foyer	HBA & AAPA Registration 8am-12pm AM Break 10-10:30am	AAPA Registration 12-5pm PM Break 3-3:30pm	Wiley-Blackwell Reception 8-10pm
Parlors	HBA Podium 8am-12pm	HBA Podium 1:45-4:45pm	Silent/Live Auction 7-10pm
Grand Ballroom I			
Grand Ballroom II	Session 7: Paleoanthropology: Early Hominids. Contributed Podium Presentations. 8am-12pm	Session 12: Language Origins & Pre-Modern Europeans: New Ways of Approaching an Old Problem. Wiley-Blackwell Invited Podium Symposium. 1-5pm	AAPA Plenary (Session 15): Bringing Fossil Casts into the Open. 6:15-7:45pm
Galleria North	Session 4: Innovation, Challenges, & New Directions in Genetic Research with Indigenous Populations. AAAG/AAPA Invited Podium Symposium. 8am-12pm	Session 9: Bioarchaeology. Contributed Podium Presentations. 1-5pm	
Galleria South	Session 5: Primate Behavior. Contributed Podium Presentations. 8am-12pm	Session 10: Primate Behavior: Foraging. Contributed Podium Presentations. 1-5pm	HBA Business Meeting 5-6:30pm
Cabinet Suite	Speaker Ready Room		
Senate Suite	Press Room		
Executive Suite	Job Interview Room		
Forum Suite	Session 8: Bioarchaeology & Forensic Case Studies of Violence: Reconstructing Context & Meaning. Invited Poster Symposium (1-15). 8-11am	Session 13: On the Verge of Modernity: Skeletal Adaptation in Recent Europeans. Invited Poster Symposium (Posters 1-10). 2-5pm	
Directors Suite		Physical Anthropology Women's Mentoring Network (PA WMN) luncheon, pre-registration required 12-1 pm AAAG Networking Event 4-5:30 pm	
Alexander's (23rd Floor)		HBA Awards Lunch 12-1:30pm	Physical Anthropology Women's Mentoring Network (PA WMN) Happy Hour 5:15-6:30 pm

Friday

Room	Friday am	Friday pm	Friday evening
Plaza Foyer	Contributed Posters (8am-4pm) Session 15: Human & Nonhuman Primate Genetics (1-30). Session 16: Functional Skeletal Anatomy (31-102). Session 17: Human & Non-Human Primate Teeth (103-138). Session 18: Primatology (139-221).		
Pavilion Ballroom East	Exhibitors 8am-4pm		
Pavilion Ballroom West	AAPA Posters (see above) 8am-4pm		
Broadway I/II/III/IV	AAPA Posters (see above) 8am-4pm		
Grand Ballroom Foyer	AAPA Registration 8am-12pm AM Break 9:45-10:30am	AAPA Registration 12-5pm PM Break 3:30-4:15pm	
Parlors	Session 22: Human Skeletal Biology: Forensics & Bioarchaeology. Contributed Podium Presentations. 8am-12pm	Session 27: Human & Nonhuman Population & Phylogenetic Studies. Contributed Podium Presentations. 2-6 pm	
Grand Ballroom I		AAPA Luncheon: Bruce Latimer. The Perils of Being Bipedal. 12-2pm	
Grand Ballroom II	Session 21: Paleoanthropology: Early <i>Homo</i> . Contributed Podium Presentations. 8am-12pm	Session 26: Early Man in South America: New Paradigms in Late Pleistocene/Early Holocene Biological Anthropology. Invited Podium Symposium. 2-6pm	AAPA Business Meeting 8-11pm
Galleria North	Session 19: Primate Functional Anatomy & Locomotor Behavior. Contributed Podium Presentations. 8am-12pm	Session 24: Reproduction/Life History. Contributed Podium Presentations. 2-6pm	
Galleria South	Session 20: Not by Bread Alone: Non-Caloric Determinants of Life History Strategies. HBA/AAPA Invited Podium Symposium. 8am-12pm	Session 25: Finding our Inner Animal: Understanding Human Evolutionary Variation via Experimental Model Systems. Invited Podium Symposium. 2-6pm	
Cabinet Suite	Speaker Ready Room		
Senate Suite	Press Room		
Executive Suite	Job Interview Room		
Council Suite			HB Editorial Board Meeting 6:30-7 pm AAAG Business Meeting 7-8pm AAAG Cocktail Hour 8-9 pm
Forum Suite	Session 23: From the Collagen Up: A Look at Scurvy Past & Present. Invited Poster Symposium. 8-11 am	Session 28: Working Nine to Five: The Future of Activity-Related Stress. Invited Poster Symposium. 2-5pm	DAA Business Meeting 7:45-9pm
Studio Suite			JHE Editorial Board Dinner 5-8pm
Directors Suite			ADA Business Meeting 7:00-9pm
Alexander's (23rd Floor)			BANDIT Happy Hour 6-7pm Primate Biology and Behavior Interest Group Functions Meeting 7-8 pm

Saturday

Room	Saturday am	Saturday pm	Saturday evening
Plaza Foyer	Contributed Posters (8am-4pm) Session 29: Human and Primate Biology: Growth, Development, Nutrition, Demography, Epidemiology, & Reproduction (1-50). Session 30: Human Adaptation & Human Variation (51-90). Session 31: Skeletal Biology: Paleopathology, Warfare, & Population History (91-114). Session 32: Paleoanthropology (115-172). Session 33: Evolution of Primates (173-209).		
Pavilion Ballroom East	Exhibitors 8am-4pm		
Pavilion Ballroom West	AAPA Posters (see above) 8am-4pm		
Broadway I/II/III/IV	AAPA Posters (see above) 8am-4pm		Student Awards Reception 6-7:30pm
Grand Ballroom Foyer	AAPA Registration 8am-12pm AM Break 10-10:30am	AAPA Registration 12-5pm PM Break 3-3:30pm	
Parlors	Session 37: Human Biology. Contributed Podium Presentations. 8am-12pm	Session 43: Human & Nonhuman Genetic Variation. Contributed Podium Presentations. 1-5pm	
Grand Ballroom II	Session 36: Paleoanthropology: Late Pleistocene. Contributed Podium Presentations. 8am-12pm	Session 42: Primate Behavior: Reproduction & Life History. Contributed Podium Presentations. 1-5pm	
Galleria North	Session 34: Bioarchaeology of Contact & Colonialism. Invited Podium Symposium. 8am-12pm	Session 40: Functional Skeletal Biology. Contributed Podium Presentations. 1-5pm	
Galleria South	Session 35: The Other Faunivory: The Significance of Insects & Insect Resources for Nonhuman Primates, Modern Humans, & Extinct Hominins. Invited Podium Symposium 8am-12pm	Session 41: Advances in Understanding Oral Health Present & Past: Interdisciplinary Insights on Sex & Gender Differences. DAA/AAPA Invited Podium Symposium. 1-5pm	
Cabinet Suite	Speaker Ready Room		
Senate Suite	Press Room	Student Awards Committee 5-6pm	
Executive Suite	Job Interview Room		
Council Suite	Education Committee Teacher Outreach. 8-2pm		
Forum Suite	Session 38: Stories from the Skeleton: Hard Tissue Research on Modern, Nonhuman Primates. Invited Poster Symposium (1-9). 8-11am	Session 45: Examining the Big Picture: Working Towards a Holistic Understanding of Secular Change in Modern Populations. Invited Poster Symposium (1-12). 2-5pm	
Studio Suite		Career Development 12-2pm	Anatomy Career Workshop 2-4pm
Directors Suite		Committee on Diversity 12-2pm	
Alexander's (23rd Floor)	Session 39: The Use of Models in Anthropological Locomotor Biomechanics: "Stand-Ins" or Bases of Comparison? Invited Poster Symposium (1-19). 8-11am	Session 44: Bioarchaeology in Western Coastal North America: Integrating Studies of Human Prehistory. Invited Poster Symposium (1-13). 2-5 pm	

Conference Schedule

For a schedule of individual AAPA poster and podium presentations, see page 17.

Monday April 9th, 2012.

Paleopathology Association Functions

6:00 pm -- 9:00 pm Registration. *Plaza Foyer.*

Tuesday April 10th, 2012.

Paleopathology Association Functions

8:00 am -- 5:00 pm Registration. *Plaza Foyer.*
 8:00 am -- 12:00 pm Workshop. *Pavilion Ballroom East.*
 2:00 pm-- 5:00 pm Podium Session. *Pavilion Ballroom East.*
 5:15 pm -- 6:15 pm Student Meeting. *Pavilion Ballroom East.*
 6:00 pm -- 10:00 pm Dinner. *Pavilion Ballroom West.*

Human Biology Association Functions

5:00 pm -- 8:00 pm Registration. *Plaza Foyer.*
 6:00 pm -- 10:00 pm Executive Committee Meeting. *Directors Suite.*

Wednesday April 11th, 2012.

Paleopathology Association Functions

8:00 am -- 12:00 pm Registration. *Plaza Foyer.*
 8:00 am -- 12:00 pm Podium Sessions. *Pavilion Ballroom East.*
 8:00 am -- 5:00 pm Poster Sessions. *Pavilion Ballroom West.*
 2:00 pm -- 5:30 pm Podium Session. *Pavilion Ballroom East.*
 5:30 pm -- 6:30 pm Student Awards Reception. *Pavilion Ballroom East.*

Human Biology Association Functions

7:30 am -- 9:00 am *American Journal of Human Biology* Editorial Board Meeting and Breakfast. *Forum Suite.*
 8:00 am -- 5:00 pm Registration. *Plaza Foyer.*
 8:00 am -- 12:00 pm Poster Session. *Broadway 1/II/III/IV.*
 1:00 pm -- 6:00 pm Plenary/Podium Session. *Grand Ballroom II.*

American Association of Physical Anthropologists Functions

7:30 am -- 6:00 pm Executive Committee Meeting. *Parlor C.*
 12:00 pm -- 1:30 pm *American Journal of Physical Anthropology* Editorial Board Luncheon. *Forum Suite.*
 5:00 pm -- 9:00 pm Registration. *Grand Ballroom Foyer.*
 6:00 pm -- 8:00 pm Undergraduate Research Symposium. *Broadway I/II.*
 8:00 pm -- 11:00 pm Welcome Reception. *Grand Ballroom I/II.*

European Virtual Anthropology Network Function

8:00 am -- 5:00 pm EVAN Toolbox Workshop. *Galleria North.*

Thursday April 12th, 2012. Morning sessions.

Human Biology Association Functions

8:00 am -- 12:00 pm Registration. *Grand Ballroom Foyer.*
 8:00 am -- 12:00 pm Podium Sessions. *Parlors.*

American Association of Physical Anthropologists Functions

8:00 am -- 5:00 pm Registration. *Grand Ballroom Foyer.*

 Thursday April 12th, 2012

8:00 am -- 4:00pm	Exhibitors. <i>Plaza Foyer and Pavilion Ballroom East.</i>
8:00 am -- 4:00 pm	Session 1: Human and Nonhuman Population and Phylogenetic Studies. Contributed Posters (1-22). <i>Plaza Level.</i>
8:00 am -- 4:00 pm	Session 2: Human Osteology/Bioarchaeology. Contributed Posters (23-116). <i>Plaza Level.</i>
8:00 am -- 4:00 pm	Session 3: Human Osteology and Forensic Anthropology. Contributed Posters (117-153). <i>Plaza Level.</i>
8:00 am -- 12:00 pm	Session 4: Innovation, Challenges, and New Directions in Genetic Research with Indigenous Populations. Co-Sponsored by the American Association of Anthropological Genetics and the American Association of Physical Anthropologists. Invited Podium Symposium. <i>Galleria North.</i>
8:00 am -- 12:00 pm	Session 5: Primate Behavior. Contributed Podium Presentations. <i>Galleria South.</i>
8:00 am -- 12:00 pm	Session 6: Dental Anthropology. Contributed Podium Presentations. <i>Broadway III/IV.</i>
8:00 am -- 12:00 pm	Session 7: Paleoanthropology: Early Hominids. Contributed Podium Presentations. <i>Grand Ballroom II.</i>
8:00 am -- 11:00 am	Session 8: Bioarchaeology and Forensic Case Studies of Violence: Reconstructing Context and Meaning. Invited Poster Symposium (1-15). <i>Forum Suite.</i>
10:00 am -- 10:30 am	Morning break. <i>Grand Ballroom Foyer.</i>

 Thursday April 12th, 2012. Afternoon sessions.

Human Biology Association Functions

12:00 pm -- 1:30 pm	Awards Luncheon. <i>Alexander's (23rd Floor).</i>
1:45 pm -- 4:45 pm	Podium Sessions. <i>Parlors.</i>

American Association of Physical Anthropologists Functions

12:00 pm -- 1:00 pm	Physical Anthropology Women's Mentoring Network (PA WMN) Meeting/Lunch. <i>Directors Suite</i>
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(Posters -- Sessions 1, 2, 3 continued from morning; see morning schedule for details.)

1:00 pm -- 5:00 pm	Session 9: Bioarchaeology. Contributed Podium Presentations. <i>Galleria North.</i>
1:00 pm -- 5:00 pm	Session 10: Primate Behavior: Foraging. Contributed Podium Presentations. <i>Galleria South.</i>
1:00 pm -- 5:00 pm	Session 11: Primate Evolution. Contributed Podium Presentations. <i>Broadway III/IV.</i>
1:00 pm -- 5:00 pm	Session 12: Language Origins and Pre-Modern Europeans: New Ways of Approaching an Old Problem. The Wiley-Blackwell Invited Podium Symposium. <i>Grand Ballroom II.</i>
2:00 pm -- 5:00 pm	Session 13: On the Verge of Modernity: Skeletal Adaptation in Recent Europeans. Invited Poster Symposium (Posters 1-10). <i>Forum Suite.</i>
3:00 pm -- 3:30 pm	Afternoon break. <i>Grand Ballroom Foyer.</i>

 Thursday April 12th, 2012

Thursday April 12th, 2012. Evening functions.

Human Biology Association Functions5:00 pm -- 6:30 pm Business Meeting. *Galleria South.***American Association of Physical Anthropologists Functions**5:15 pm -- 6:30 pm Physical Anthropology Women's Mentoring Network (PA WMN) Happy Hour
*Alexander's (23rd floor)*6:00 pm -- 8:00 pm Race and Representation Forum. *Broadway III.*6:00 pm -- 8:00 pm Ethics Forum. *Broadway I.*6:00 pm -- 8:00 pm Teaching Biological Anthropology in the 21st Century. *Broadway II.*6:15 pm -- 7:45 pm Plenary Session: **Bringing Fossil Casts into the Open.** *Grand Ballroom II.*7:00 pm -- 10:00 pm Silent/Live Auction. *Parlors and Grand Ballroom I.*8:00pm -- 10:00 pm Wiley-Blackwell Reception. *Grand Ballroom Foyer.*

Friday April 13th, 2012. Morning sessions.

Human Biology Association Functions8:00 am -- 12:00pm. Session 20: **Not by Bread Alone: Non-Caloric Determinants of Life History Strategies.** Invited Podium Symposium co-sponsored by the Human Biology Association and the American Association of Physical Anthropologists. *Galleria South.***American Association of Physical Anthropologists Functions**8:00 am -- 5:00 pm Registration. *Grand Ballroom Foyer.*8:00 am -- 4:00 pm Exhibitors. *Plaza Foyer and Pavilion Ballroom East.*8:00 am -- 4:00 pm Session 15: **Human and Nonhuman Primate Genetics.** Contributed Posters (1-30).
*Plaza Level.*8:00 am -- 4:00 pm Session 16: **Functional Skeletal Anatomy.** Contributed Posters (31-102). *Plaza Level.*8:00 am -- 4:00 pm Session 17: **Human and Non-Human Primate Teeth.** Contributed Posters (103-138).
*Plaza Level.*8:00 am -- 4:00 pm Session 18: **Primateology.** Contributed Posters (139-221). *Plaza Level.*8:00 am -- 4:00 pm Session 19: **Primate Functional Anatomy and Locomotor Behavior.** Contributed
Podium Presentations. *Galleria North.*8:00 am -- 12:00 pm Session 20: **Not by Bread Alone: Non-Caloric Determinants of Life History Strategies.** Invited Podium Symposium co-sponsored by the Human Biology Association and the AAPA. *Galleria South.*8:00 am -- 12:00 pm Session 21: **Paleoanthropology: Early *Homo*.** Contributed Podium Presentations. *Grand Ballroom II.*8:00 am -- 12:00 pm Session 22: **Human Skeletal Biology: Forensics and Bioarchaeology.** Contributed
Podium Presentations. *Parlors .*8:00 am -- 11:00am Session 23: **From the Collagen Up: A Look at Scurvy Past and Present.** Invited Poster
Symposium. *Forum Suite.*9:45 am -- 10:30 am Morning break. *Grand Ballroom Foyer.*

 Friday April 13th, 2012

Friday April 13th, 2012. Afternoon sessions.

American Association of Physical Anthropologists Functions
 12:00 pm -- 2:00 pm AAPA Luncheon: Bruce Latimer. **The Perils of Being Bipedal.** *Grand Ballroom I.*

(Posters -- Sessions 15, 16, 17, 18 continued from morning; see morning schedule for details.)

 2:00 pm -- 6:00 pm Session 24: **Reproduction/Life History.** Contributed Podium Presentations. *Galleria North.*

 2:00 pm -- 6:00 pm Session 25: **Finding our Inner Animal: Understanding Human Evolutionary Variation via Experimental Model Systems.** Invited Podium Symposium. *Galleria South.*

 2:00 pm -- 6:00 pm Session 26: **Early Man in South America: New Paradigms in Late Pleistocene/Early Holocene Biological Anthropology.** Invited Podium Symposium. *Grand Ballroom II.*

 2:00 pm -- 6:00pm Session 27: **Human and Nonhuman Population and Phylogenetic Studies.** Contributed Podium Presentations. *Parlors.*

 2:00 pm -- 5:00 pm Session 28: **Working Nine to Five: The Future of Activity-Related Stress.** Invited Poster Symposium. *Forum Suite.*

 3:30 pm -- 4:15 pm Afternoon break. *Grand Ballroom Foyer.*

Friday April 13th, 2012. Evening functions.

American Association of Physical Anthropologists Functions
 8:00 pm -- 11:00 pm Business Meeting. *Grand Ballroom II.*
American Association of Anthropological Genetics Functions
 6:30 pm -- 7:00 pm Human Biology Editorial Board Business Meeting. *Council Suite.*

 7:00 pm -- 8:00 pm AAAG Business Meeting. *Council Suite.*

 8:00 pm -- 9:00 pm AAAG Cocktail Hour. *Council Suite.*
American Dermatoglyphics Association Functions
 7:00 pm -- 9:00 pm Business meeting. *Directors Suite.*
BANDIT (Biological ANthropology Developing Investigators Troop)
 6:00 pm -- 7:00 pm Happy Hour. *Alexander's (23rd Floor).*
Dental Anthropology Association Functions
 7:45 pm -- 9:00 pm Business meeting. *Forum Suite.*
Journal of Human Evolution Editorial Board Functions
 5:00 pm -- 8:00 pm Editorial Board Dinner. *Studio Suite.*
Primate Biology and Behavior Interest Group Functions
 7:00 pm -- 8:00 pm Meeting. *Alexander's (23rd floor).*

 Saturday April 14th, 2012

Saturday April 14th, 2012. Morning sessions.

American Association of Physical Anthropologists Functions

- 8:00 am -- 5:00 pm Registration. *Grand Ballroom Foyer.*
- 8:00 am -- 4:00 pm Exhibitors. *Plaza Foyer and Pavilion Ballroom East.*
- 8:00 am -- 2:00 pm Education Committee Outreach Program - "Fossils, Bones and Primates: Enriching High School Teaching." *Council Suite.*
- 8:00 am -- 4:00 pm Session 29: **Human and Primate Biology: Growth, Development, Nutrition, Demography, Epidemiology, and Reproduction.** Contributed Posters (1-50). *Plaza Level.*
- 8:00 am -- 4:00 pm Session 30: **Human Adaptation and Human Variation.** Contributed Posters (51-90). *Plaza Level.*
- 8:00 am -- 4:00 pm Session 31: **Skeletal Biology: Paleopathology, Warfare, and Population History.** Contributed Posters (91-114). *Plaza Level.*
- 8:00 am -- 4:00 pm Session 32: **Paleoanthropology.** Contributed Posters (115-172). *Plaza Level.*
- 8:00 am -- 4:00 pm. Session 33: **Evolution of Primates.** Contributed Posters (173-209). *Plaza Level.*
- 8:00 am-12:00 pm. Session 34: **Bioarchaeology of Contact and Colonialism.** Invited Podium Symposium. *Galleria North.*
- 8:00 am -- 12:00 pm Session 35: **The Other Faunivory: The Significance of Insects and Insect Resources for Nonhuman Primates, Modern Humans, and Extinct Hominins.** Invited Podium Symposium. *Galleria South.*
- 8:00 am -- 12:00 pm Session 36: **Paleoanthropology: Late Pleistocene.** Contributed Podium Presentations. *Grand Ballroom II.*
- 8:00 am -- 12:00 pm Session 37: **Human Biology.** Contributed Podium Presentations. *Parlors.*
- 8:00 am -- 11:00 am Session 38: **Stories from the Skeleton: Hard Tissue Research on Modern, Nonhuman Primates.** Invited Poster Symposium (1-9). *Forum Suite.*
- 8:00 am -- 11:00 am Session 39: **The Use of Models in Anthropological Locomotor Biomechanics: "Stand-Ins" or Bases of Comparison?** Invited Poster Symposium (1-19). *Alexander's (23rd Floor).*
- 10:00 am -- 10:30 am Morning break. *Grand Ballroom Foyer.*

Saturday April 14th, 2012. Afternoon sessions.

American Association of Physical Anthropologists Functions

- 12:00 pm -- 2:00 pm Committee on Diversity. *Directors Suite.*
- 12:00 pm -- 2:00 pm Career Development. *Studio Suite*
- 2:00 pm -- 4:00 pm Anatomy Career Workshop. *Studio Suite*

(Posters -- Sessions 29, 30, 31, 32, 33 continued from morning; see morning schedule for details.)

 Saturday April 14th, 2012

- 1:00 pm -- 5:00 pm Session 40: **Functional Skeletal Biology**. Contributed Podium Presentations. *Galleria North*.
- 1:00 pm -- 5:00 pm Session 41: **Advances in Understanding Oral Health Present and Past: Interdisciplinary Insights on Sex and Gender Differences**. Co-sponsored by the Dental Anthropology Association and the American Association of Physical Anthropologists. Invited Podium Symposium. *Galleria South*.
- 1:00 pm -- 5:00 pm Session 42: **Primate Behavior: Reproduction and Life History**. Contributed Podium Presentations. *Grand Ballroom II*.
- 1:00 pm -- 5:00 pm Session 43: **Human and Nonhuman Genetic Variation**. Contributed Podium Presentations. *Parlors*.
- 2:00 pm -- 5:00 pm Session 44: **Bioarchaeology in Western Coastal North America: Integrating Studies of Human Prehistory**. Invited Poster Symposium (1-13). *Alexander's (23rd Floor)*.
- 2:00 pm -- 5:00 pm Session 45: **Examining the Big Picture: Working Towards a Holistic Understanding of Secular Change in Modern Populations**. Invited Poster Symposium (1-12). *Forum Suite*.
- 3:00 pm -- 3:30 pm Afternoon break. *Grand Ballroom Foyer*.

 Saturday April 14th, 2012. Evening sessions.

American Association of Physical Anthropologists Functions

- 5:00 pm -- 6:00 pm Student Awards Committee Meeting. *Senate Suite*.
- 6:00 pm -- 7:30 pm Student Awards Reception. *Broadway I/II/III/IV*.

AAPA Poster and Podium Presentation Schedule.

For a schedule of all conference events, see page 11

Thursday. All Day Sessions.

Session 1	HUMAN AND NONHUMAN POPULATION AND PHYLOGENETIC STUDIES. Contributed Posters. Plaza Level. Chair: John Dudgeon
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
1	Comparing neutral markers, selective markers and human cranial morphology. Are human skulls neutral? T.F. ALMEIDA, D.V. BERNARDO.
2	The worldwide phylogeography for a haplotype block in human Xp22.2. C.G. AMORIM, T. HÜNEMEIER, V.R. PAIXÃO-CÔRTEZ, M. BORTOLINI, S.L. BONATTO, F.M. SALZANO.
3	A comparative genomic investigation of the role for the NMDA receptor gene <i>GRIN3A</i> in synaptic plasticity. J.L. BAKER, B. WOOD, K.N. STERNER, C.C. SHERWOOD, T. DUKA, D.E. WILDMAN.
4	Genetics and identity: ethnogenesis in a Jamaican Maroon community. J.P. BENN TORRES, H. LOMBARD.
5	A combined molecular/morphological analysis of colobine interrelationships and the phylogenetic position of <i>Paracolobus</i>. S.L. CARNATION.
6	Craniofacial differences between modern and archaeological Northeastern Thai skeletal populations. W.J. CHAN.
7	Archaeogenetics and paleodemographic estimation of founding populations, and features of residential geography on Rapa Nui (Easter Island). J. DUDGEON, M. TROMP, A. COMMENDADOR.
8	Ancient DNA reveals the population origin of the Eastern Xinjiang. S. GAO, H. LI, C. LI, H. ZHOU.
9	A genetic perspective on the evolution of longevity at the Middle Paleolithic to Upper Paleolithic transition. A. GOLDBERG, K. MACK, A. BIGHAM.
10	Analysis of Chuvash mtDNA points to Finno-Ugric origin. O.M. GRAF, S.M. JOHNSON, J. MITCHELL, S. WILCOX, G. LIVSHITS, M.H. CRAWFORD.
11	Development and annotation of molecular markers from three neotropical primate (Platyrrhini) species. N.M. JAMESON, K. XU, S. YI, D.E. WILDMAN.
12	Concurrent isolation and amplification of primate genomes, transcriptomes and microbiomes from small tissue (hair) samples. J.M. KAMILAR, A. MCINTOSH, B.J. BRADLEY.
13	An ancient DNA perspective on the Iron Age “princely burials” from Baden-Württemberg, Germany. E.J. LEE, C. STEFFEN, M. HARDER, B. KRAUSE-KYORA, N. VON WURMB-SCHWARK, A. NEBEL.
14	Maternal origins of Accompong Maroons. H.M. LOMBARD, J. BENN TORRES.
15	Rates of Neandertal introgression in genic versus intergenic regions of the human genome. K. MACK, A. GOLDBERG, A. BIGHAM.
16	High mitochondrial mutation rates estimated from deep-rooting Costa Rican pedigrees. L. MADRIGAL, J.P. ARROYO, D. GODFREY, C. FLANSBURG, R. PEREIRA, L. CASTRI, D. LUISELLI, D. PETTENER, M. MELENDEZ-OBANDO, R. VILLEGAS-PALMA, R. BARRANTES, R. HENRIETA, G. BARBUJANI.
17	The seminal importance of the Ipiutak and Birnirk in ancestor-descendent relationships across the North American Arctic. B. MALEY.
18	Almost Carioca: hybridization between introduced populations of <i>Callithrix jacchus</i> and <i>C. penicillata</i> in Rio de Janeiro State, Brazil. J. MALUKIEWICZ, A.D. GRATIVOL, C.R. RUIZ-MIRANDA, A.C. STONE.
19	Vikings, merchants and pirates at the top of the world: Y-chromosomal signatures of recent and ancient migrations in the Faroe Islands. A.E. MANN, E. MAGNUSSEN, C.R. TILQUIST.

 Thursday April 12th, 2012 All Day Poster Sessions

20	PRLR sequence diversity in owl monkeys (<i>Aotus azarae</i>) and other paternal care-giving primates suggests the maintenance of variation by balancing selection. A.M. MCINTOSH, P.L. BABB, E. FERNANDEZ-DUQUE, T.G. SCHURR.
21	Genetic variation in Mi'kmaq populations from Nova Scotia and its implications for the history of Algonquian populations in northeastern North America. A.C. OWINGS, M.C. DULIK, S.I. ZHADANOV, J.B. GAIESKI, A. COPE, D. DOREY, T.G. SCHURR, T. GENOGRAPHIC CONSORTIUM.
22	Date estimates for major mitochondrial haplogroups in Yemen. D.N. VYAS, V. ČERNÝ, A. AL-MEERI, C.J. MULLIGAN.
Session 2	HUMAN OSTEOLOGY/BIOARCHAEOLOGY. Contributed Posters. Plaza Level. Chair: Kristina Killgrove
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
23	Fetus into child: comparison of three methods for age estimation in young non-adults from Punta Teatinos, Chile . M.P. ALFONSO-DURRUTY, J.L. THOMPSON.
24	In the middle: sternal malformation at the Angel site. E.L. AUSEL.
25	From bread to porridge: an analysis of dietary shifts during Roman rule at Karanis, Egypt. A.E. AUSTIN.
26	Tooth size, sex differences, and health: an odontometric analysis of a modern Thai sample. S.R. BADGER.
27	An odontometric investigation of biological affinities of the Yashkuns of Northern Pakistan. A.M. BARTON, B.E. HEMPHILL.
28	Preliminary osteological analysis of human skeletal remains from El Cerro del Teú Archaeological Project. H.J. BAUER-CLAPP, B. QUINTERO, V.R. PÉREZ.
29	The diet of Bronze and Iron Age nomadic pastoralist populations from eastern Eurasia. J.J. BEACH.
30	Comparison of age and sex-related changes in trabecular and cortical histomorphometry in a Roman archaeological population. P. BEAUCHESNE, S.C. AGARWAL.
31	The Great Irish Famine: producing “lifeways” for victims and survivors using isotope ratios and elemental concentrations. J. BEAUMONT, J. GEBER, N. POWERS, J. LEE-THORP, A. WILSON, A. GLEDHILL, J. MONTGOMERY.
32	Dental ablation in ancient Nubia: evulsion at the Ginefab School site . K.L. BOLHOFNER, B.J. BAKER.
33	Skeletal trauma in a Black South African Apartheid-era sample from the Raymond Dart Collection. B.P. BRENTON, R.R. PAINE, A. TANG.
34	A new method of dentine microsampling of deciduous teeth for stable isotope analysis. N.M. BURT, S. GARVIE-LOK.
35	A potential Late Pleistocene human skeleton in Hoyo Negro, a submerged cave site in Quintana Roo, Mexico. J.C. CHATTERS, D. RISSOLO, P. LUNA ERREGUERENA, A. NAVA BLANK.
36	Osteoarthritis as a means to reassociate commingled skeletal remains. C.M. CHEVERKO, D. STEADMAN.
37	Diet reconstruction in prehistoric Rapa Nui and its implications for models of resource depletion. A. COMMENDADOR, W. RAUH, J. DUDGEON, K. ESH, B. FINNEY.
38	Mitochondrial DNA analysis of human remains recovered from the Fontabelle section of Bridgetown, Barbados. C.R. CRAIN, L. EPP, L. ALLISON, B.M. KEMP, K. FARMER.
39	A new method for the study of the biomechanical properties of human long bones and its application to ecogeographic and behavioral variation. T. DAVIES, J.T. STOCK.
40	Let's get real about MSMs: reliability in scoring techniques. C.B. DAVIS, K. SHULER, M.E. DANFORTH, K. HENDRON.

 Thursday April 12th, 2012 All Day Poster Sessions

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| 41 | Anatomical and biological reconstruction of mortuary rituals: case studies from colonial Eten, Lambayeque, Peru. A.L. DEMARCO, H.D. KLAUS, S.J. APPLGATE. |
| 42 | Medieval famine and health: skeletal markers of childhood physiological stress in survivors of the Great Famine, 1315-1322. S. DEWITTE, J. POLLARD. |
| 43 | Building an ecosystem of data: expanding the Open Research Scan Archive (ORSA) through institutional collaboration. A.N. DHODY, J. MONGE, L.M. JAHNKE, J.E. BOWMAN, S. COX, P.T. SCHOENEMMANN. |
| 44 | Cultural modification of head shape among archaeological populations of the Western Chaco area, Argentina. H. DRUBE, E. SILVERA, S. MARTÍNEZ, B. DESÁNTOLO, G. LAMENZA, S. SALCEDA. |
| 45 | Going head to head: FORDISC vs CRANID in the determination of ancestry from craniometric data. M. ELLIOTT, M. COLLARD. |
| 46 | Ancient mortuary rituals in a high altitude population in Nepal: cut marks among shaft tomb burials from Upper Mustang . J.T. ENG. |
| 47 | A three dimensional analysis of femoral cortical canal structure in Middle Holocene, Lake Baikal hunter-gatherer-fishers. K.J. FACCIA, H. BUIE, M.A. KATZENBERG, V.I. BAZALIISKII, O.I. GORIUNOVA. |
| 48 | The human skeletal remains from Herculaneum: new evidence from the excavation of the <i>fornici</i> 7, 8, 9, 10 and 11. L. FATTORE, L. BONDIOLI, P. GARNSEY, P.F. ROSSI, A. SPERDUTI. |
| 49 | Dem dry bones: cyclododecane as a tool in osteological analysis. A.E. FAZLOLLAH, M.J. WOOD. |
| 50 | An example of ischiopubic hypoplasia in medieval Nubia. J.M. FLEISCHMAN, E.R. NIESPODZIEWANSKI, A.E. KENDELL, A. SOLER. |
| 51 | A regression method for the timing of micro enamel defects. R. FRANCA, A. GOODMAN. |
| 52 | Estimation of femoral second moments of area from shaft's external dimensions (AP and ML diameters). L. FRIEDL. |
| 53 | The Noua on horses? Rethinking the hypothesis of a horseback riding culture. S.A. GLOUX. |
| 54 | Age-at-death estimation in an historic Italian sample: a test of the auricular surface and transition analysis methods. K. GODDE, S.M. HENS. |
| 55 | You don't have a leg to stand on: a case study of femo-tibial fusion from a cave in the Andahuaylas Province, Peru. K.A. GREEN, D.S. KURIN. |
| 56 | Residential mobility and social identity in the periphery: strontium isotope analysis of archaeological tooth enamel from southeastern Arabia. L.A. GREGORICKA. |
| 57 | Isotopic dietary analysis and molecular sex identification of adults and juveniles from medieval Great Moravia. C.M. HALFFMAN, K.C. HOOVER, P. VELEMÍNSKÝ. |
| 58 | Age-at-death estimation in bioarchaeology: does a uniform prior perform better than an informative prior in transition analysis?. S.M. HENS, K. GODDE. |
| 59 | French medieval funerary practices: quantitative and biological analysis of the skeletal remains buried in burial vaults. P. HERVIEU, M. SIGNOLI, E. HERRSCHER. |
| 60 | Bilateral positioning of nutrient foramina in the human tibia, femur, and humerus. Z.R. HUBBELL, J.H. GOSMAN. |
| 61 | Stature and mortality in post-medieval London . G. HUGHES-MOREY. |
| 62 | Changing gender roles in prehistoric America: physical activity with the transition to agriculture in the Midwest. P.R. HUSMANN. |
| 63 | The spatial distribution of skeletal stress indicators in a 4th century Romano-British sample: a study using ArcGIS. L.L. JENNY. |
| 64 | Unlocking the past: bioarchaeology and the history of Denver's Cheesman Park. A.M. KALB, C.M. GAITHER. |
| 65 | Palaeopathology and urban decline at Imperial Gabii (Italy). K. KILLGROVE. |
| 66 | The efficacy of traditional dental lifestyle markers in describing actual lifestyle. L.M. KING, M. HUBBE, C. TORRES-ROUFF. |
| 67 | Human remains processing for skeletal collections using laboratory "burials" . A.J. KOEHL, H.J. EDGAR. |

 Thursday April 12th, 2012 All Day Poster Sessions

68	Temporal trends in dental health and diet in the archaeological populations of Utah . D.V. KOPP, D.D. GRAHAM.
69	Development of bone strength and rigidity at Neolithic Catalhoyuk: adaptation and lifestyle in early Holocene farmers from south-central Anatolia. C.S. LARSEN, E.M. GAROFALO, C.B. RUFF.
70	GPA, TW2RUS, TW3RUS and FELS – a comparative study on bone-age of the left hand and wrist . S. LARSEN, S. DEMANT, N. LYNNERUP.
71	An oral health assessment of coastal and inland early and middle Neolithic south China and Taiwan. A.J. LAUER, M. WANG, T. JIAO, G. SUN.
72	Lower limb activity in the Cis-Baikal: musculoskeletal stress markers among middle Holocene Siberian foragers . A.R. LIEVERSE, V.I. BAZALIISKII, O.I. GORIUNOVA, A.W. WEBER.
73	Refining dietary estimates at Machu Picchu using combined dental macro/microwear and isotopic analyses. S.V. LIVENGOOD, B.L. TURNER, F.L. WILLIAMS.
74	Ancient Arkansas: skeletal remains from the Isgrig South site. A.M. LOPINTO.
75	Dental nonmetric analysis of Tecolote Pueblo: a study of biological distance. A.M. MALLARD.
76	More mobile than most? AP tibial expansion in the DeArmond mound. D.M. MCCARTHY, PH.D., K.B. HUFNAGL.
77	Bone microstructure and behaviour in “gracile” and “robust” adult males from the Medieval Period, Canterbury, UK. J.J. MISZKIEWICZ, P. MAHONEY.
78	Timelines in teeth: using micro-CT scans of partially mineralized human teeth to develop a new isotope sampling strategy. J. MONTGOMERY, J. BEAUMONT, K. MACKENZIE, A. GLEDHILL, R. SHORE, S. BROOKES, P. SALMON, N. LYNNERUP.
79	Understanding how sex and pathology affected frailty during the Amarna Period (BC 1351-1334). T. MONTGOMERY.
80	Methodological advances in TCA age-estimation technique . S. NAJI, J. BLONDIAUX, T. COLARD, M. ROKSANDIC, J. BOCQUET-APPEL.
81	Long in the tooth: tracing migration using stable isotopes in dental enamel from Byzantine St. Stephen’s. M.A. NUNEZ, L.A. GREGORICKA, J.M. ULLINGER, A. COOPER, S.G. SHERIDAN.
82	Dental Modification in a Prehistoric Chamorro Population from Tumon Bay, Guam. N.M. PARR.
83	Biological and spatial structure of an Early Classic Period cemetery at Charco Redondo, Oaxaca. K.S. PAUL, C.M. STOJANOWSKI.
84	Status, health, and lifestyle in Iron Age Britain: a bioarchaeological study of elites and non-elites from East Yorkshire. J.J. PECK.
85	Differential diagnosis of severe dental hypoplastic defects in two juveniles from the Pre-Classic site of El Carrizal, Oaxaca, Mexico. S.S. PHILLIPS.
86	A comparative study of treponemal disease in the tibiae of two south Florida archaeological populations: Fort Center (8GL12) and Highland Beach (8PB11). K.L. PHILMON, D. BROADFIELD, M. HARRIS, P. FERDINANDO.
87	Neolithic population movement in Central Anatolia. M.A. PILLOUD, C.S. LARSEN.
88	Relative long bone proportions and developmental stress in a modern Thai population. K.R. RECTENWALD.
89	Virtual anthropology. M.C. REID.
90	Medieval Polish diet in a world of flux. L.J. REITSEMA, T. K. ZŁOWSKI, D. MAKOWIECKI.
91	Bioarchaeological analysis of the Miami One 8DA11 skeletal remains: a glimpse into the population’s past health and population structure. A. RIVARA, L. NOCHE-DOWDY, A. HUMPHRIES, J. POWELL, C. ECHAZABAL, E.H. KIMMERLE.
92	Strontium tells all at Tell Dothan: exploring migration with strontium isotope analysis. S.T. SAIYED, J.R. HOFFMANN, J.P. CARTWRIGHT, L.A. GREGORICKA, J.M. ULLINGER, S.G. SHERIDAN.
93	Radiogenic strontium isotope analysis from the Hopewell affiliated Brown’s Bottom site and baseline data for the central Scioto River Valley, OH . E.A. SCHACH, K.J. KNUDSON, C. CARR.

 Thursday April 12th, 2012 All Day Poster Sessions

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| 94 | Comparison of the humeral cancellous bone in Neolithic human populations and present day people . H. SCHERF, J. WAHL, J. HUBLIN, K. HARVATI. |
| 95 | Activity patterns in New Kingdom, Third Intermediate, and Napatan period Nubia: a diachronic study of osteoarthritis and enthesal remodeling at Tombos. S.A. SCHRADER. |
| 96 | Coins, kids, and culture: an examination of grave goods and health at the Drawsko 1 cemetery site (17th – 18th centuries). A.B. SCOTT, T.K. BETSINGER. |
| 97 | Dental calculus: a new proxy for estimating stable carbon and nitrogen isotope compositions. R. SCOTT, S.R. POULSON, L. DORIO. |
| 98 | The relationship between Body Mass Index and tuberculosis: evidence from the English archaeological record. A.E. SOHLER. |
| 99 | The Mis Island Medieval Nubian Skeletal Collection at Michigan State University. A. SOLER, C.V. HURST, T.W. FENTON. |
| 100 | “Leading” bones in the degenerative joint disease scoring: evaluation of the consistency of using incomplete joints in an archaeological sample. A. SPERDUTI, L. BONDIOLI. |
| 101 | Excavations of St. George’s Caye Cemetery, Belize. L.C. SPRINGS, E. ERHART, J. GARBER. |
| 102 | Dental flurosis in ancient Cuma, Italy. M. TORINO, S. NAJI, P. MUNZI, J. BRUN. |
| 103 | Defining local and regional strontium isotopic variability in the southeastern Maya periphery. W.R. TRASK. |
| 104 | Compensatory mechanisms of multiple debilitating traumas: a case study from the Oneida State Custodial Asylum in Rome, New York . L.A. TREMBLAY CRITCHER. |
| 105 | Dietary microfossils from Rapa Nui dental calculus: does regional variability provide evidence for subsistence practices?. M. TROMP, J. DUDGEON. |
| 106 | The Ford Cranial Collection: new online resources for research and education. C. VANSICKLE, Z.D. COFRAN, K. MUNNELLY, C.R. MEYER. |
| 107 | Mortuary practices of a medieval cemetery in southern Italy. J.M. VOLLNER, C.V. HURST, T.W. FENTON. |
| 108 | Morphological correlates of human hip osteoarthritis . C.S. WALKER, E. MAYER, S.E. CHURCHILL. |
| 109 | Naton Beach site: an examination of the skeletal remains of prehistoric Pre-Latte and Latte burials . C.K. WALTH. |
| 110 | An analysis of limb element asymmetry in an ancestral Puebloan population. E.B. WAXENBAUM, K.A. SIRAK. |
| 111 | Integrating ⁸⁷Sr/⁸⁶Sr and $\delta^{18}\text{O}$ values of archaeological enamel with geological and environmental water baseline isotopic data: A case study in geographic origins from Nasca, Peru. E. WEBB, C. WHITE, K. KNUDSON, F. LONGSTAFFE. |
| 112 | How old was ‘Geriatric’? Estimating the age of old individuals with Calibrated Expert Inference. S. WEISE, J.L. BOLDSSEN, J. GAMPE, G.R. MILNER. |
| 113 | Calcaneal enthesophytes: etiology beyond activity. E. WEISS. |
| 114 | The influence of European contact on health and demography in the Caribbean: the case of El Chorro de Maità, Cuba. D.A. WESTON. |
| 115 | Osteoperiostitis sex differences in southern German medieval and postmedieval populations. L.L. WILLIAMS, C.S. LARSEN. |
| 116 | The Neolithic demographic transition (NDT) and patterns in oral health: the Southeast Asian experience. A. WILLIS, M.F. OXENHAM. |

 Thursday April 12th, 2012 All Day Poster Sessions

Session 3	HUMAN OSTEOLOGY AND FORENSIC ANTHROPOLOGY. Contributed Posters. Plaza Level. Chair: M. Anne Katzenberg
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
117	The ‘Adjusted Parabolic Index’: a revised approach to evaluating osteoporosis in human ribs . A.M. AGNEW, S.D. STOUT.
118	Bone area as a histomorphometric variable for evaluating age-related changes. J.M. ANDRONOWSKI, C. CROWDER.
119	The use of semilandmark methods to discriminate modern human crania by sex and ancestry: a pilot study. C.M. ASTORINO.
120	Histomorphometric differences in tibial cortical bone based on sampling location. S. BLATCH, M.A. STREETER, M.S. DRAPEAU.
121	Preliminary analysis of human skeletal remains recovered from a mid-nineteenth century cemetery in downtown New Haven, CT . S.A. BROWNLEE, G.P. ARONSEN, H. ECKELS, N.F. BELLANTONI.
122	The intercondylar notch as a tool in identifying sex. A.L. CARUTH.
123	Human ribs six through nine: sexual dimorphism and seriation using geometric morphometrics. S.C. CURRAN, J. GRIFFITH.
124	Mapping moose: moose as a proxy for humans in the mapping of stable isotopes for forensic purposes. K.K. DEWEY.
125	First time analysis of Tell Abraq proximal femora using micro 3-D scanning: analytic implications for age estimation and beyond . A. DUTT, S.I. PRAJAPATI, D.L. MARTIN, C. KELLER, J.G. GELOVANI, G. TOMLINSON.
126	Taking a second look: NamUs and unidentified skeletal remains cases in Utah. J.A. HASLAM, D.V. KOPP.
127	Sex estimation from the greater sciatic notch: a morphometric approach. A.L. HESSEY, A. MCKEOWN.
128	Let’s talk about sex: testing multiple methods for sex estimation on metacarpals and metatarsals from Um-El Jamal, Northern Jordan. C.A. HOOP, G. MADDEN.
129	Sex determination using 3D coordinate landmark data of the skull: a test using a CT sample. R.D. HOPPA, A.R. KLALES, L.J. LIDSTONE, A.B. SCOTT, N. LYNNERUP.
130	Bilateral aging asymmetry of the auricular surface. K.B. HUFNAGL, D.M. MCCARTHY.
131	Executions at the Hamam? – Forensic investigations in a shaft well from Medieval Ayasuluk (Turkey). F. KANZ, G. FORSTENPOINTNER, A. GALIK, K. GROSSCHMIDT, S. PFEIFFER-TAS, D. RISSER.
132	Identification of historic individuals: the unknown sailor from the HMAS Sydney II. M.A. KATZENBERG, D. DONLON.
133	Sex estimation using pubic bone morphology in a modern South African sample: a test of the Klaes <i>et. al</i> method. M.W. KENYHERCZ.
134	Sexual dimorphism in the 12th thoracic vertebra in human skeletal remains. M.D. KISS, P.H. MOORE-JANSEN.
135	Sex estimation using the mastoid process. A. KITTOE.
136	A comparison of hunting and butcher knife trauma on semifleshed and unfleshed pig bones. S.B. LETSCH, K. FOLINSBEE.
137	A comparison of gross morphology and histomorphometric age-at-death estimation techniques on a known forensic sample. S.R. MAVROUDAS, C.M. CROWDER.
138	The influence of height and weight on adult skeletal age estimation . C.E. MERRITT.
139	Meta-analysis of forensic stature estimation. M.K. MOORE, S. RICHTER.

Thursday April 12th, 2012 All Day Poster Sessions

140	Ancestry and the osteometric assessment of the femur. E.C. OKRUTNY, J.E. BYRD, J. JIN.
141	Sexual dimorphism in the lower vertebral column: a discriminant function analysis using contemporary skeletal series. R.F. PASTOR.
142	A diachronic comparison of the skeletal fusion rate of the knee joint. S.G. RAGER, T.J. SETZER.
143	An independent validation using CT data of two methods to quantify uniqueness in the frontal sinuses for forensic anthropological applications. S.M. RICHER, N. LYNNERUP, R.D. HOPPA.
144	Osteological manifestation and diagnosis of Cocaine-Induced Midline Destructive Lesion: A new understanding of an overlooked condition and its relevance to forensic anthropology. K. RUBIN.
145	Recent trends in the use of human remains for anthropological research during international human rights investigations . M. SAINÉ.
146	The effect of microclimate characteristics on time to skeletonization in clothed and nude <i>Sus scrofa domestica</i> subjects in an arid SW US environment. A.M. SHARPLIN.
147	An evaluation of medical imaging techniques for craniometric data collection. A.M. SMYTH, M.D. VINER, G.J. CONLOGUE, S.A. BROWNLEE, G.P. ARONSEN.
148	Back from the dead: an osteobiography of a depression era miner from central Nevada. D.L. SPENCER, R. MCQUEEN, P. SIIG, G. SCOTT.
149	A comparative analysis of serrated and non-serrated knife trauma. C.E. TEGTMEYER, M.D. HAMILTON.
150	Reliability of classic scoring methods for age estimation of pelvic bone applied to CT and laser scans . C. VILLA, C. PRIMEAU, J. BUCKBERRY, C. CATTANEO, N. LYNNERUP.
151	The effect of climatic conditions on burnt bone fragmentation. K.B. WATERHOUSE.
152	Determination of sex from differences in tooth size in a modern admixed population from New Mexico: relative efficacy of permanent and deciduous teeth. C.A. WRIGHT, B.E. HEMPHILL.
153	Sagittal suture complexity and its relationship to cranial shape and cranial vault thickness. C.J. ZAMBRANO.

Thursday. Morning Sessions.

Session 4	<p>INNOVATION, CHALLENGES, AND NEW DIRECTIONS IN GENETIC RESEARCH WITH INDIGENOUS POPULATIONS. CO-SPONSORED BY THE AMERICAN ASSOCIATION OF ANTHROPOLOGICAL GENETICS AND THE American Association of Physical Anthropologists. Invited Podium Symposium. <i>Galleria North</i>.</p> <p>Chair: Deborah A. Bolnick</p> <p>The study of genetic variation in indigenous human populations has long been a focus of anthropological genetic research, but new technological, legal, social, and ethical developments have recently begun to reshape this field of inquiry in important ways. Over the last decade, advances in next-generation sequencing and other high-throughput technologies have made it possible to address new scientific questions and to use new methodologies to answer more traditional questions about indigenous peoples. Lawsuits like the Havasupai's case against the Arizona Board of Regents have drawn attention to indigenous concerns about genetic studies, and awareness of the social and political repercussions of indigenous genomic research has also increased in recent years. Furthermore, the nature of interactions between scientists and indigenous communities is evolving as new collaborations are established, new ethics guidelines are released, and new oversight processes are developed.</p> <p>In this symposium, we will examine the current state of genetic research with indigenous populations, highlighting recent innovative studies as well as relevant ethical, legal, and social issues. We will discuss the challenges and opportunities facing anthropological geneticists today, and consider the future of genetic research with indigenous peoples.</p>
8:00-8:15	<p>Introduction to the AAAG symposium: new developments and current issues in genetic research with indigenous populations. D. BOLNICK.</p>

 Thursday April 12th, 2012 Morning Sessions

8:15-8:30	An interdisciplinary genomic approach to the study of adaptation and population histories in Sub-Saharan Africa. L.B. SCHEINFELDT, S. SOI, A. FROMENT, J. BODO, C. WAMBEBE, S.A. TISHKOFF.
8:30-8:45	Ancient and modern genetic diversity of Iñupiat populations from the Alaskan North Slope. J.C. TACKNEY, J.A. RAFF, M. RZHETSKAYA, A.M. JENSEN, D.H. O'ROURKE, M.G. HAYES.
8:45-9:00	The extent of rare, population specific genomic copy number variation: Implications for indigenous human populations. O. GOKCUMEN.
9:00-9:15	Inferences of human adaptive evolution from next-generation sequencing data. J.M. AKEY.
9:15-9:30	Genomic and metagenomic research with Peruvian indigenous communities. A.J. OBREGON-TITO, R.Y. TITO, D. FUENTES-DELGADO, P. SPICER, C.M. LEWIS.
9:30-9:45	From scientific specimen to indigenous cultural property: the collection and use of Australian indigenous DNA samples since the 1960s. E.E. KOWAL.
9:45-10:00	Facilitating discussion and awareness with the Summer Internship for Native Americans in Genomics (SING). R.S. MALHI.
10:00-10:15	Break
10:15-10:30	Assessing the impact of the Havasupai lawsuit on genetic research studies. N.A. GARRISON.
10:30-10:45	Developing research oversight processes for a Native American community. P.N. OSSORIO.
10:45-11:00	Multicultural governance of biocapital? Human genetic information, property, and contentious identities in Colombia. A. BARRAGAN.
11:00-11:15	Genomic sovereignty in practice: promise, paradox, peril. J.E. REARDON.
11:15-11:30	Discussant, M. CRAWFORD
11:30-11:45	Discussant, K. TALLBEAR
11:45-12:00	Discussion
Session 5	PRIMATE BEHAVIOR. Contributed Podium Presentations. <i>Galleria South</i>. Chair: Zarin P. Machanda
8:00-8:15	Molecular assessment of dispersal in black-and-white ruffed lemurs (<i>Varecia variegata</i>). A.L. BADEN, E.E. LOUIS, JR., B.J. BRADLEY.
8:15-8:30	Of fugitives and refuges: coexistence despite intense interspecific competition in hylobatids. A.A. ELDER.
8:30-8:45	The influence of the forest edge on activity patterns and postural behaviour of <i>Propithecus coquereli</i> in northwest Madagascar. K.C. MCGOOGAN, S.M. LEHMAN.
8:45-9:00	Associations between dominance rank grooming network strength and centrality among male chimpanzees at Ngogo. D.P. WATTS, T.H. WEBSTER.
9:00-9:15	Egalitarian female relationships in <i>Colobus vellerosus</i> (ursine colobus): individualistic hierarchies with high linearity and stability, moderate bidirectionality, and low expression. E.C. WIKBERG, J.A. TEICHROEB, I. BĂDESCU, P. SICOTTE.
9:15-9:30	It is better to receive than to give: costs and benefits of social grooming in vervet monkeys (<i>Chlorocebus aethiops</i>). B.T. WREN, M.J. REMIS, T.R. GILLESPIE.
9:30-9:45	The functions of mutual grooming among wild chimpanzees. Z.P. MACHANDA, I.C. GILBY, R.W. WRANGHAM.
9:45-10:00	The social organization of <i>Lemur catta</i> in the region of Cap Sainte-Marie, Madagascar. E.A. KELLEY.
10:00-10:15	Social relationships influence gestural communication in wild chimpanzees. B.R. PAV.
10:15-10:30	Break
10:30-10:45	Social network analysis with insights for disease transmission dynamics in wild chimpanzees. J. RUSHMORE, D. CAILLAUD, R.M. STUMPF, L. MATAMBA, S. ALTIZER.

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10:45-11:00	Social states, behavioral flexibility and social evolution. K.B. STRIER, P.C. LEE.
11:00-11:15	Rates of lethal aggression in chimpanzees depend on the number of adult males rather than measures of human disturbance. M.L. WILSON, C. BOESCH, T. FURUICHI, I.C. GILBY, C. HASHIMOTO, G. HOHMANN, N. ITOH, T. MATSUZAWA, J. MITANI, D.C. MJUNGU, D. MORGAN, M. NAKAMURA, J. PRUETZ, A.E. PUSEY, C. SANZ, N. SIMMONS, F. WHITE, D.P. WATTS, K. ZUBERBUHLER, R.W. WRANGHAM.
11:15-11:30	Infectious disease risk in the evolution of culture. C.M. MCCABE, C.L. NUNN, S.M. READER.
11:30-11:45	Do parasites constrain group size? A phylogenetic comparative study and meta-analysis. C.L. NUNN, J.L. RIFKIN, L.Z. GARAMSZEGI, C.M.MCCABE.
11:45-12:00	Individual distinctiveness in wild western gorilla (<i>Gorilla gorilla</i>) vocalizations. R. SALMI, D.M. DORAN-SHEEHY.
Session 6	DENTAL ANTHROPOLOGY. Contributed Podium Presentations. <i>Broadway III/IV</i>. Chair: Daniel H. Temple
8:00-8:15	Does this face make my teeth look big? Molar size, size-adjustment, and dietary adaptation in strepsirrhine primates. J.E. SCOTT.
8:15-8:30	Masticatory biomechanics and hard object feeding: cranial adaptations in <i>Cercocebus torquatus</i>. L.C. FITTON, J. SHI, M.J. FAGAN, P. O'HIGGINS.
8:30-8:45	Having their cake and eating it, too—the role of dental specialization in saki feeding ecology. M.A. NORCONK, M. VERES.
8:45-9:00	Age-related changes of the occlusal surface geometry in humans and great apes. A. MARGVELASHVILI, C.P. ZOLLIKOFER, M.S. PONCE DE LEÓN.
9:00-9:15	Discrete dental traits in chimpanzees. V.C. PILBROW.
9:15-9:30	Parametric model of a bunodont molar. M.A. BERTHAUME, E.R. DUMONT, L.R. GODFREY, I.R. GROSSE.
9:30-9:45	Fundamental approaches to dental wear. P.W. LUCAS.
9:45-10:00	A fine grained but non destructive method to determine the timing of enamel hypoplasia. G.P. MCFARLANE.
10:00-10:15	The structural morphology of incisor and molar teeth. Tracking the evolutionary pathways in Late Pleistocene humans. P. BAYLE, L. BONDIOLI, A. MAZURIER, C. ZANOLLI, R. MACCHIARELLI.
10:15-10:30	Break
10:30-10:45	The Neolithic transition in the Maghreb: a study through dental morphological data. F. CANDILIO, A. CUCINA, A. COPPA.
10:45-11:00	Reconstruction of systemic stress using incremental microstructures of enamel in an individual from the Late/Final Jomon period, Japan. D.H. TEMPLE, M. NAKATSUKASA, J.N. MCGROARTY.
11:00-11:15	Population biodistance in pre-European contact central México, Veracruz, and the Yucatán . C. WILLERMET, H.J. EDGAR, C. RAGSDALE.
11:15-11:30	Variation in Australian Aboriginal diets: contrasting dental patterns from South Australia. R. SCOTT, J. LITTLETON.
11:30-11:45	Biomechanical relationships between chewing efficiency and dental morphology in modern humans. M.F. LAIRD, H. PONTZER.
11:45-12:00	A comparison of permanent tooth formation in four African and two British groups. H. LIVERSIDGE, M. FOLAYAN, A. ADENIYI, F. ELAMIN.
Session 7	PALEOANTHROPOLOGY: EARLY HOMINIDS. Contributed Podium Presentations. <i>Grand Ballroom II</i>. Chair: Margaret J. Schoeninger
8:00-8:15	Variation in hominoid vertebral formulae: implications for the evolution of the hominin vertebral column. S.A. WILLIAMS.

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8:15-8:30	Costly signaling in young male chimpanzees and humans: implications for early Hominin behavior. H.M. SHERROW.
8:30-8:45	Kinematics and morphometrics of the radiocarpus in anthropoids with implications for reconstructing the evolution of hominin wrist mechanics. C.M. ORR.
8:45-9:00	The chimpanzee is not a valid behavioral model for <i>Ardipithecus ramidus</i>. K. SAYERS, C. LOVEJOY.
9:00-9:15	Revisiting Pliocene hominid phylogeny: a postcranial perspective. Y. HAILE-SELASSIE, B.M. LATIMER.
9:15-9:30	Anatomical configuration of the <i>Australopithecus afarensis</i> shoulder: evidence from a new clavicle (KSD-VP-1/1f). S.M. MELILLO.
9:30-9:45	Bipedalism, obstetrics, and the evolution of constraints. M.W. GRABOWSKI.
9:45-10:00	Human fat deposition and upright posture. M. CARTMILL, K. BROWN.
10:00-10:15	Break
10:15-10:30	Diets of early hominins: alternative hypotheses for the isotope data . M.J. SCHOENINGER, M. BEASLEY, A.W. FROEHLE, C.M. KELLNER.
10:30-10:45	Dental fracture mechanics and the reconstruction of hominin bite forces . P.J. CONSTANTINO, M.M. SKINNER.
10:45-11:00	Combining occlusal fingerprint analysis and computer-based methods for 3D digital reconstruction of Sts 52. S. BENAZZI, O. KULLMER, S. DIETER, G.W. WEBER.
11:00-11:15	Reconstructing the habitat mosaic associated with <i>Australopithecus robustus</i>. J.K. BROPHY.
11:15-11:30	Feeding biomechanics of OH 5 assessed using finite element analysis. A.L. SMITH, S. BENAZZI, G.W. WEBER, C.F. ROSS, P.C. DECHOW, I.R. GROSSE, M.A. SPENCER, B.G. RICHMOND, Q. WANG, B.W. WRIGHT, D.E. SLICE, C.D. BYRON, D.S. STRAIT.
11:30-11:45	Strontium isotope ratios of mammalian fossils from Malapa, South Africa . D.J. DE RUITER, M. SPONHEIMER, S. COPELAND, J.A. LEE-THORP, L.R. BERGER, P. LEROUX.
11:45-12:00	The primitive aspects of the foot and ankle of <i>Australopithecus sediba</i>. J.M. DESILVA, B. ZIPFEL, R.S. KIDD, K.J. CARLSON, S.E. CHURCHILL, L.R. BERGER.
Session 8	BIOARCHAEOLOGY AND FORENSIC CASE STUDIES OF VIOLENCE: RECONSTRUCTING CONTEXT AND MEANING. Invited Poster Symposium. <i>Forum Suite</i> . Chair: Cheryl P. Anderson and Debra L. Martin
	7:30-8:00 am Poster set-up 11:00-11:30 am Poster take-down
	Bioarchaeology and forensic anthropology present complementary perspectives for examining violence in both past and contemporary societies. An important goal of any investigation of conflict and trauma is to place the skeletal data into the larger social, political, or historical context. One way to get a deeper understanding of the motivations and consequences of violence for different categories of participants (e.g., victims, aggressors, captives, warriors) is to examine the different roles that individual agents and groups play and how they interact in a specific location. An example of this approach is teasing out the victims from the attackers in cases of indigenous or colonial warfare or sectarian conflicts. Careful analysis of the human remains, detailed observations on the burial context, and ethnographic or witness reports all can aid in providing a more accurate and nuanced reconstruction of past events. This session will highlight case studies of antemortem and perimortem trauma in contemporary, historic and precontact contexts. The focus will be on the theories and/or methods that are used to interpret violent interactions by identifying both the perpetrators of violence and those who suffered as a result of their actions. These integrated bioarchaeological-forensic approaches will aid in constructing the contexts where violence takes place. Ultimately, both subdisciplines aim to reconstruct and explain complex human behavior and so can benefit from directly sharing case studies, theories and methods.
1	Identifying victims of colonial violence: a historic case study from Northern Mexico. C.P. ANDERSON, D.L. MARTIN, J.L. THOMPSON.
2	Injury recidivism, trauma, and pathology in the multi-ethnic community at Grasshopper Pueblo (AD 1275-1400). K.M. BAUSTIAN, D.L. MARTIN, R.P. HARROD, A.J. OSTERHOLTZ.
3	The contribution of forensic anthropology to national identity in Chile: a case study from the Patio 29 mass grave. E.M. DEVISSER, K.E. LATHAM, M. INTRIAGO LIEVA.

 Thursday April 12th, 2012 Morning Sessions

4	Using a regional approach to identifying aggressors in the archaeological record. W.N. DUNCAN.
5	Killed in action? A biomechanical cross-sectional analysis of femora of supposed battle victims from the Middle Bronze Age site of Weltzin, Germany. S. FLOHR, E. SPANAGEL, U. BRINKER, H. KIERDORF, U. KIERDORF.
6	Identifying sharp force defects: an analysis of ambiguous skeletal trauma recovered from the wreck of the royal Swedish battleship <i>Kronan</i>. A. KJELLSTROM, M.D. HAMILTON.
7	Murder, sacrifice, or veneration: reconstructing the identities of the victims of lethal violence interred in Room 33. R.P. HARROD, D.L. MARTIN.
8	Conflict and ethnic identity among the post-collapse Chanka of Andahuaylas, Peru (ca. AD 1000-1400). D.S. KURIN.
9	Trauma in cross-cultural perspective: a comparative bioarchaeological study of prehistoric trauma in the Americas. P.M. LAMBERT.
10	Complexity in cutmarks, burning and breakage of human bones at La Quemada: Distinctive patterns from different contexts. D.L. MARTIN, B.A. NELSON, V.R. PEREZ.
11	Comparative interpretation of perimortem trauma from Spanish Conquest of Inca Empire, Peru. M.S. MURPHY, B. SPATOLA.
12	Bioarchaeological analysis and repatriation of the massacred Yaqui men, women and children studied by Hrdlicka. V.R. PÉREZ, H. BAUER-CLAPP.
13	The determination of homicide vs. suicide in gunshot wounds. V.H. STEFAN.
14	Classic Maya warfare and human skeletal trophies: victims and aggressors. R. STOREY.
15	Face me like a man (or, like a woman): antemortem nasal fractures in pre-Columbian San Pedro de Atacama, Chile. C. TORRES-ROUFF, L.M. KING.

Thursday. Afternoon Sessions.

Session	BIOARCHAEOLOGY. Contributed Podium Presentations. <i>Galleria North</i> .
9	Chair: Corina M. Kellner
1:00-1:15	Investigating cranial morphology of early, archaic and recent Native American samples: a preliminary alternative interpretation to the peopling of the Americas debate. B. DUDZIK, D. ECHEVERRY.
1:15-1:30	Evidence for long-term gene flow on the Balkan Peninsula using dental nonmetric data: Identity at the Greek colony of Apollonia, Albania. B.K. MCILVAINE, L.A. SCHEPARTZ, C.S. LARSEN.
1:30-1:45	Paleoclimatological reconstruction using $\delta^{18}\text{O}$ analysis in incremental sections of human dentine: a preliminary study using a catastrophic cemetery sample. C. STANTIS, E. KENDALL, A. LAMB, V. MUELLER, J. EVANS, J. MONTGOMERY.
1:45-2:00	A draft genome of <i>Yersinia pestis</i> from victims of the Black Death. K.I. BOS, V.J. SCHUENEMANN, G. GOLDING, H.A. BURBANO, N. WAGLECHNER, B.K. COOMBES, J.B. MCPHEE, S.N. DEWITTE, H.N. POINAR, J. KRAUSE.
2:00-2:15	Spina bifida in a pre-Columbian Cuban population. S.D. ARMSTRONG, R. RODRIGUEZ, M. ROKSANDIC, C. MATHESON.
2:15-2:30	Bioarchaeological analysis of unlooted tombs from Cocahuicho in Nasca, Peru (AD 650-750) reveals disease and trauma patterns during the period leading up to Wari Imperial incursion. C.M. KELLNER, K. VAUGHN, H. VAN GIJSEGHEM, V. WHALEN.
2:30-2:45	TMJ osteoarthritis and modernisation: Influence of the industrial revolution on disease prevalence. C.J. RANDO, S. HILLSON, D. ANTOINE.
2:45-3:00	Examining the evolution of Egyptian excerebration and evisceration through the IMPACT mummy database. A.D. WADE, A.J. NELSON.

 Thursday April 12th, 2012 Afternoon Sessions

3:00-3:15	Contributions of phenetic relationship and stable isotope analysis ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{18}\text{O}$) to the study of a mortality crisis in the catacomb of Saints Peter and Marcellinus in Rome (1st-3rd century AD). K. SALESSE, É. DUFOUR, C. WURSTER, J. BRUZEK, R. GIULIANI, D. CASTEX.
3:15-3:30	Break
3:30-3:45	The interrelationship of diet and status in early medieval Alamannic societies. H. SCHUTKOWSKI, N. SPEITH.
3:45-4:00	Mobility and dietary composition in Quillagua (northern Chile) during the Late Intermediate Period (AD 1000-1400). F. SANTANA, M. HUBBE, M. URIBE.
4:00-4:15	Mobility and subsistence in the Early Intermediate Period cemetery of Villa El Salvador XII. M.P. RHODE, J.J. PECK.
4:15-4:30	Human dietary and mobility patterns of a prehistoric population from Sigatoka, Fiji: a reconstruction using stable isotope analysis. B. PHAFF, D. BURLEY, M. RICHARDS.
4:30-4:45	Basketmaker mortuary patterns at Falls Creek. D.M. MULHERN, M.C. CHARLES.
4:45-5:00	From popular culture to scientific inquiry: A bioarchaeological analysis of vampires in post-medieval Poland. T.K. BETSINGER, A.B. SCOTT.
Session 10	PRIMATE BEHAVIOR: FORAGING. Contributed Podium Presentations. <i>Galleria South</i>. Chair: Paul A. Garber
1:00-1:15	Male resource defense in Argentine tufted capuchin monkeys (<i>Cebus apella nigrinus</i>): consequences for intergroup dominance relationships and home range quality. C.J. SCARRY.
1:15-1:30	GIS analysis of the ranging behavior, group cohesiveness, and patch use of bearded sakis (<i>Chiropotes sagulatus</i>) in the Upper Essequibo Conservation Concession, Guyana. C.A. SHAFFER.
1:30-1:45	Spatio-temporal distribution of food resources and group-level memory shape inter-group contact patterns in white-faced capuchins (<i>Cebus capucinus</i>) and Verreaux's sifaka (<i>Propithecus v. verreauxi</i>). D. CAILLAUD, M.C. CROFOOT, R.J. LEWIS, S.V. SCARPINO, L.A. MEYERS.
1:45-2:00	The use of route-based mental maps for foraging in wild Bolivian saddleback tamarins. P.A. GARBER, L.M. PORTER.
2:00-2:15	Mantled howler monkey spatial foraging decisions: implications for cognitive evolution. M.E. HOPKINS.
2:15-2:30	Co-occurrence patterns suggest that interspecific competition shapes communities of primates, birds, bats and squirrels in Borneo. L. BEAUDROT, M.J. STRUEBIG, E. MEIJAARD, B. VAN BALEN, A.J. MARSHALL.
2:30-2:45	Cold, wet and hungry? fluctuations in frugivore populations in response to extreme climactic events. M.C. CROFOOT, S. WRIGHT, J. GIACALONE.
2:45-3:00	Simulated termite fishing in captive bonobos: an analysis of tool construction and socioecological factors influencing tool use acquisition and behavior. K.J. BOOSE, F.J. WHITE.
2:45-3:00	Calibrating a conservation strategy for silvery gibbons (<i>Hylobates moloch</i>). N. MALONE, A. WADE, M. WEDANA ADI PUTRA, M. REISLAND, M. SELBY.
3:00-3:15	Break
3:15-3:30	How do wild gibbons decide where to sleep? . J.E. BERNER, U.H. REICHARD.
3:30-3:45	Urinary C-peptide indicates male chimpanzees do not experience significant energetic stress at Ngogo, Kibale National Park, Uganda. M.M. BEUERLEIN, R.G. BRIBIESCAS.
4:00-4:15	Ecological and social influences on habitat use by Bornean orangutans. A.J. MARSHALL, L.H. BEAUDROT, K.L. FEILEN, L.G. BELL, M. GROTE.
4:15-4:30	Catalytic cooperators: individual effects on hunting and patrolling among male chimpanzees. I.C. GILBY, M.L. WILSON.
4:30-4:45	Variation in the nutritional quality of the diets of two populations of Bornean orangutans (<i>Pongo pygmaeus wurmbii</i>): implications for population density. E.R. VOGEL, M.E. HARRISON, H. MORROGH-BERNARD, M.A. VAN NOORDWIJK.

 Thursday April 12th, 2012 Afternoon Sessions

4:45-5:00	Diet, behavior and nutrition in captive western lowland gorillas (<i>Gorilla gorilla gorilla</i>): Implications for chronic disease in apes and humans. B. SMITH, M.J. REMIS.
Session 11	PRIMATE EVOLUTION. Contributed Podium Presentations. <i>Broadway III/IV</i>. Chair: Robert Anemone
1:00-1:15	Hypocones and pseudohypocones in Eocene primates: a microCT scanning approach to an old problem. R. ANEMONE, M. SKINNER, W. DIRKS.
1:15-1:30	New material of <i>Anchomomys</i> (Adapoidea, Primates) from the Spanish fossil site of Caenes (Salamanca). J. MARIGÓ, R. MINWER-BARAKAT, S. MOYÀ-SOLÀ.
1:30-1:45	New material of <i>Biretia</i>, the oldest undoubted anthropoid from Afro-Arabia. E.R. SEIFFERT, E.L. SIMONS.
1:45-2:00	Environments of early Miocene Rusinga Island and Songhor: evidence from the dental microwear of tragulids. P.S. UNGAR, J.R. SCOTT, K.P. MCNULTY, W.E. HARCOURT-SMITH, T. LEHMANN, H.M. DUNSWORTH.
2:00-2:15	Fossil forelimbs of <i>Simiolus</i> from Moruorot, Kenya. J.B. ROSSIE, M. GUTIERREZ, E. GOBLE.
2:15-2:30	New morphological diagnoses and specimen attributions of the Kisingiri <i>Proconsul</i> species, <i>P. nyanzae</i> and <i>P. heseloni</i>. K.P. MCNULTY, D.R. BEGUN, J. KELLEY.
2:30-2:45	The role of canine reduction in diagnosing the earliest hominins: lessons from a Miocene ape. H. GLOWACKA, G.T. SCHWARTZ, W.H. KIMBEL.
2:45-3:00	Ape-like mobility in the semi-terrestrially adapted foot of <i>Kenyapithecus africanus</i>. I.D. ARNEY, M.L. MCCROSSIN, B.R. BENEFIT.
3:00-3:15	Break
3:15-3:30	The face of <i>Afropithecus turkanensis</i> and the ancestral morphotype of the Catarrhini. D.R. BEGUN.
3:30-3:45	Never going back again? On the reversibility of mandibular symphyseal fusion. J.B. LACK, J.E. SCOTT, A.S. HOGUE, M.J. RAVOSA.
3:45-4:00	Evolution of human encephalization: evidence from a comparative analysis of brain size and fat storage. A.F. NAVARRETE, C.P. VAN SCHAIK, K. ISLER.
4:00-4:15	Effects of seasonality on brain size evolution: evidence from nonhuman primates. J.T. VAN WOERDEN, C. VAN SCHAIK, K. ISLER.
4:15-4:30	Brain size and endocranial morphology of <i>Antillothrix</i> (Holocene, Dominican Republic, Hispaniola) . K.L. ALLEN, R.F. KAY, K.D. HUNT, C.D. BEEKER, G.W. CONRAD, J. KELLER.
4:30-4:45	Ligers and tignons and pizzlies, oh my!: the morphological consequences of intergeneric hybridization in the cranium of a rheboon (<i>Macaca mulatta</i> x <i>Papio hamadryas</i>). J.L. JOGANIC, K.E. WILLMORE, J.T. RICHTSMEIER, J. ROGERS, J.M. CHEVERUD.
4:45-5:00	Regional specializations in the chimpanzee neocortex: pyramidal neurons are more branched and spiny in the prefrontal cortex . S. BIANCHI, C.D. STIMPSON, A.L. BAUERNFEIND, W.D. HOPKINS, K. SEMENDEFERI, B. JACOBS, P.R. HOF, C.C. SHERWOOD.
Session 12	LANGUAGE ORIGINS AND PRE-MODERN EUROPEANS: NEW WAYS OF APPROACHING AN OLD PROBLEM. THE WILEY-BLACKWELL SYMPOSIUM. Invited Podium Symposium. <i>Grand Ballroom II</i>. Chair: David W. Frayer and Marina Lozano
	Language ability in Neandertals and their European ancestors has long been a contentious issue. New developments from a variety of disciplines in primatology, paleogenetics, human paleontology and archaeology are changing our views of the linguistic capabilities of these early Europeans. This collection of presentations offers multiple perspectives from scholars studying living primates, material culture and symbolism, ancient DNA, and pre-Neandertal and Neandertal fossils. All provide new ways of addressing the linguistic capability in fossils, especially, pre-modern Europeans.
1:00-1:15	Competing models of language evolution: what counts as evidence?. K.R. GIBSON.
1:15-1:30	An ape's view of language and handedness: consequence, correlation or coincidence?. L.F. MARCHANT, W.C. MCGREW.

 Thursday April 12th, 2012 Afternoon Sessions

1:30-1:45	Did the origins of human language involve changes in the insula?. B.C. CAMPBELL, N.L. HIRN.
1:45-2:00	Hominin tool-making: laterality, language, and learning. N.T. UOMINI.
2:00-2:15	Weighing the evidence: the significance of symbolic behavior among European Neandertals. A. NOWELL.
2:15-2:30	Neandertal paleogenomics and the origins of language. C. LALUEZA-FOX.
2:30-2:45	Skeletal evidence for handedness throughout growth and development. A. BLACKBURN.
2:45-3:00	Language from endocasts... "If it looks like a duck..." . R.L. HOLLOWAY.
3:00-3:15	Break
3:15-3:30	On the origin of language: the Atapuerca evidence. I. MARTINEZ, R.M. QUAM, M. ROSA, P. JARABO, C. LORENZO, A. BONMATÍ, A. GÓMEZ-OLIVENCIA, A. GRACIA, J.L. ARSUAGA.
3:30-3:45	Teeth and handedness of <i>Homo heidelbergensis</i> from Sima de los Huesos site (Sierra de Atapuerca, Spain). M. LOZANO, J. BERMÚDEZ DE CASTRO, E. CARBONELL, J. ARSUAGA.
3:45-4:00	Hands, laterality and language: hand morphology in the Sima de los Huesos site (Sierra de Atapuerca, Spain). C. LORENZO, J. CARRETERO, J. ARSUAGA, I. MARTÍNEZ, A. GRACIA, R. QUAM.
4:00-4:15	The cochlear labyrinth of Krapina Neandertals. M.E. BEALS, J. RADOVČIĆ.
4:15-4:30	Right-handedness in Regourdou 1. D.W. FRAYER, V. VOLPATO, R. MACCHIARELLI, D. GUATELLI-STEINBERG, I. FIORE, L. BONDIOLI.
4:30-4:45	Discussant, M.H. WOLPOFF

Session 13 ON THE VERGE OF MODERNITY: SKELETAL ADAPTATION IN RECENT EUROPEANS. Invited Poster Symposium. *Forum Suite*.

Chair: Christopher B. Ruff, Brigitte Holt, Markku Niskanen, and Vladimír Sládek

1:30-2:00 pm Poster set-up
5:00-5:30 pm Poster take-down

Evolution of the postcranial skeleton is often assumed to end with the appearance of “early anatomically modern humans” in the Late Pleistocene. However, the skeleton has continued to evolve and adapt to new environmental conditions, both natural and human-induced, over the past 30,000 years. Europe is the most densely sampled region in the world over this time period, and thus presents an ideal opportunity to assess the changes that have occurred in response to such factors as increased sedentism, urbanization, and mechanization, changes in social structure, and climatic change. In this symposium, we address these issues through morphological and biomechanical analyses of over 2000 skeletons sampled from throughout Europe and spanning the Late Paleolithic through 20th century. The primary focus is on body size and shape, reconstructed from various skeletal indicators (including anatomical reconstruction of stature), and long bone robusticity, determined from radiographic and external contour assessments of cross-sectional diaphyseal geometry. Topics to be considered include temporal and regional variation, sexual dimorphism, upper limb asymmetry, relationships between axial and appendicular structure and entheses morphology and diaphyseal strength, and aging patterns and other demographic considerations. The results will have wide implications for our understanding of the most recent changes in body form characterizing modern humans.

1	Age-related patterns in postcranial robusticity. G. AGOSTINI, S. REEDY, B. HOLT, C. RUFF, D. TOMPKINS, M. NISKANEN, V. SLÁDEK, M. BERNER, H. GARVIN, E. GAROFALO, E. SCHUPLEROVA, M. HORA, J. ROMAN.
2	Variation in sexual dimorphism of postcranial robusticity and body proportions in European Holocene populations . M. BERNER, V. SLÁDEK, C. RUFF, B.M. HOLT, M. NISKANEN, P. GALETA, E. SCHUPLEROVÁ, M. HORA, J. ROMAN, H.M. GARVIN, E.M. GAROFALO, D. TOMPKINS.
3	Past human manipulative behavior in the European Holocene as assessed through humeral asymmetry. K. FARKAŠOVÁ, V. SLÁDEK, M. BERNER, C. RUFF, B. HOLT, M. NISKANEN, D. SOSNA, P. GALETA, E. SCHUPLEROVÁ, M. HORA, J. ROMAN, H. GARVIN, E. GAROFALO, D. TOMPKINS.
4	Postcranial robusticity trends in Europe across the last 30,000 years. B. HOLT, C. RUFF, M. NISKANEN, V. SLÁDEK, H. GARVIN, E. GAROFALO, D. TOMPKINS, M. BERNER, J. JUNNO, R. VILKAMA.
5	Vertebral cross-sectional properties –temporal trends and influence of physical activity. J. JUNNO, M. NISKANEN, H. MAIJANEN, M.T. NIEMINEN, J. NIINIMÄKI, J. TUUKKANEN, C. RUFF.

 Thursday April 12th, 2012 Afternoon Sessions

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|----|---|
| 6 | Are loading patterns reflected in the relationship between musculoskeletal stress markers and biomechanical properties of the humeral diaphysis?. S.T. NIINIMÄKI, M.E. NISKANEN. |
| 7 | Temporal trends and regional differences in body size and shape of Europeans from the Late Pleistocene to recent times. M. NISKANEN, C. RUFF, B. HOLT, V. SLÁDEK, M. BERNER, H. GARVIN, E. GAROFALO, D. TOMPKINS, J. JUNNO, H. MAIJANEN, A. SALMI, S. NIINIMÄKI, T. HEIKKILÄ, R. VILKAMA, K. SALO. |
| 8 | New techniques for estimating stature and body mass in European skeletal samples . C.B. RUFF, B. HOLT, M. NISKANEN, V. SLÁDEK. |
| 9 | Human postcranial morphology: trends in the Central European Holocene record. V. SLÁDEK, M. BERNER, C. RUFF, D. SOSNA, P. GALETA, P. VELEMINSKY, E. SCHUPLEROVA, M. HORA, J. ROMAN, A. PANKOWSKA. |
| 10 | Mortality and stature in European antiquity . D.L. TOMPKINS, B. HOLT, C. RUFF, M. NISKANEN, V. SLÁDEK, M. BERNER. |

Thursday. Evening Session.

Session 14 **PLENARY SESSION: "BRINGING FOSSIL CASTS INTO THE OPEN". Grand Ballroom II.**
 Chair: John Hawks

6:15-7:45 *The annual AAPA meeting gives many opportunities for the membership to engage with the latest research and information about human biology and evolution. At many of our meetings, members have not only presented about their research but have brought fossil casts, scans and other materials to show first-hand. In the past, these have included some of the most exciting new discoveries, with more than a few of the most controversial debates started over casts at the meetings. This year's plenary session, "Bringing Fossil Casts into the Open", furthers this long tradition, bringing together casts and electronic materials, many of them being shown at national meetings for the first time. This session represents the cooperation and assistance of several institutes, museums and AAPA members to present materials that most members may never have had the opportunity to see in person. The session is an "open lab" format, for members to explore, investigate, and bring information back from the meetings to enhance both research and teaching. We hope that bringing these materials together will create opportunities for new insights and comparisons, or maybe kick-start the next great debate about human evolution.*

Friday. All Day Sessions.

Session 15 **HUMAN AND NONHUMAN PRIMATE GENETICS. Contributed Posters. Plaza Level.**
 Chair: Christopher R. Tillquist

7:30-8:00 am Poster set-up
 4:00-4:30 pm Poster take-down

10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion
 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion

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|---|---|
| 1 | Phylogeographic mitochondrial DNA genetic analysis of five Native American populations from lower Central America. N.F. BALDI SALAS, P.E. MELTON, R. BARRANTES, M.H. CRAWFORD. |
| 2 | Maternal marks of admixture in Cape Coloreds of South Africa. K.G. BEATY, D.L. PHILLIPS, M. HENNEBERG, M.H. CRAWFORD. |
| 3 | Beyond natural selection: Exploring the role of non-adaptive reasoning in undergraduate students' evolutionary explanations. E.P. BEGGROW, R.H. NEHM. |
| 4 | A test of cross-species exome sequencing in the rhesus macaque (<i>Macaca mulatta</i>). C.M. BERGEY, R.L. RAAUM. |
| 5 | The <i>APOE</i> gene appears functionally monomorphic in chimpanzees (<i>Pan troglodytes</i>). B.J. BRADLEY, A. MCINTOSH, C. BENNETT, S.F. ANESTIS, D.P. WATTS, T.H. WEBSTER, B. FONTENOT. |

 Friday April 13th, 2012 All Day Poster Sessions

6	Divergence of catarrhine toll-like receptor 4 predicted shape and electrostatics and the evolution of LPS-mediated sepsis resistance in old world monkeys. J.F. BRINKWORTH.
7	Ancient DNA analysis suggests temporal stability in mitochondrial genomes of the Northwest Coast. Y. CUI, J. LINDO, J.W. JOHNSON, J. CYBULSKI, R. CARLSON, D. ARCHER, R.S. MALHI.
8	Quantitative measures of iris color using high resolution photographs. M. EDWARDS, A. GOZDZIK, K. ROSS, J. MILES, E.J. PARRA.
9	Optimizing enrichment strategies for next-generation sequencing using ancient TB . K.M. HARKINS, M.A. RUBEL, L. PFISTER, A.C. STONE.
10	The human dental arch - fluctuating genetic influences throughout development. T.E. HUGHES, G.C. TOWNSEND.
11	A comparison of heritability and evolvability estimates in a baboon sample. B.I. HULSEY, B.M. AUERBACH, G.S. CABANA.
12	Maternal genetic structure of the Poqomchi' Maya of eastern Guatemala. A.E. JUSTICE, M.H. CRAWFORD.
13	Genetic snapshot from ancient nomads of Xinjiang. H. LI, S. GAO, C. LI, Y. ZHANG, W. ZENG, D. WEI, H. ZHOU.
14	Evolution of a HoxD11 enhancer in primates. A.L. MACHNICKI, C. LOVEJOY, C. CHIU.
15	The highly polymorphic human cytochrome P450 (CYP) 2A6 gene: examining diversity and nicotine metabolism in a central African foraging population. H.A. MANN, B.M. KEMP, R.J. SULLIVAN, E.H. HAGEN.
16	Ancient DNA from the Angel Mounds Archaeological Site. C. MARSHALL, F.A. KAESTLE.
17	Disentangling human demographic processes? ...What mtDNA simulations teach us. A.T. MIRÓ-HERRANS, C. MULLIGAN.
18	Population genetics, dispersal and kinship among two social groups of squirrel monkeys (<i>Saimiri sciureus</i>). M.J. MONTAGUE, A. DI FIORE.
19	Designing a hierarchical probe assay to identify native specific Y haplogroups in admixed populations. T.D. PARRISH, A.E. JUSTICE, S.M. JOHNSON, K.G. BEATY, C. PHILLIPS-KRAWCZAK, P. WILLIAMS, M.H. CRAWFORD.
20	Understanding the transcriptome of craniosynostosis: a step forward. A.B. POTTER, J.L. RHODES.
21	Neurological and signaling pathways are associated with variation in skin color. E.E. QUILLEN, R. DUGGIRALA, J.E. CURRAN, M.C. CARLESS, T.D. DYER, H.H. GORING, L. ALMASY, D.M. LEHMAN, J. BLANGERO.
22	Post-European contact Native American female and male population histories inferred from the analysis of mitochondrial DNA and Y-chromosomes. M.P. ROGERS, D. GOLDBERG, C. HUGHES, A. RODE, J.W. JOHNSON, R.S. MALHI.
23	Natural selection and celiac disease. A.J. SAMS.
24	Anthropological usefulness of forensically useful ancestry (AIM) and phenotype informative markers (PIM). M.S. SCHANFIELD, K. BUTLER, M. PECK, J. HART, D. PODINI.
25	Y-Genotyping of the J haplogroup in Yemeni samples. T.J. SCOTT, A.T. MIRÓ-HERRANS, S. MCNULTY, V. PAPASTAVROS, C. MULLIGAN.
26	Assessing relatedness within and among groups of Bolivian tamarins using several microsatellite loci . J.A. SPROSS, A. DI FIORE, T.R. DISOTELL.
27	Tabula incondita: Mixed phylogeographic signals found within a megabase of chromosome 9. C.R. TILLQUIST.
28	Adaptive evolution and ancestral resurrection of anthropoid estrogen receptor β . A. WECKLE, Z. HOU, C. CHEN, J. XING, K.N. STERNER, J.L. BAKER, R. ROMERO, D.E. WILDMAN.
29	Developing STR loci for snub-nosed monkeys (<i>Rhinopithecus roxellana</i>) using next-generation sequencing technology. C. YAN, M.R. SHATTUCK, J. THIMMAPURAM, D. VULLAGANTI, R. MALHI.
30	Human bacterial DNA from dental calculus: a new source of genetic material. C.P. DE LA FUENTE, S.V. FLORES, M.L. MORAGA.

 Friday April 13th, 2012 All Day Poster Sessions

Session	FUNCTIONAL SKELETAL ANATOMY. Contributed Posters. Plaza Level.
16	Chair: Mark N. Coleman
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
31	3D geometric morphometric analysis of the hamate in extant hominoids. S. ALMECJA, C.M. ORR, M.W. TOCHERI.
32	Phylogeography of the Sulawesi macaques based on 3D geometric morphometrics. M. ANDERSON, S.R. FROST.
33	3D geometric morphometric analysis of the proximal epiphysis of the humerus of hominoids: functional interpretation, locomotor evolution and variability. J. ARIAS-MARTORELL, J.M. POTAU, G. BELLO-HELLEGOUARCH, A.M. PÉREZ-PÉREZ.
34	<i>Papio</i> facial growth and ontogenetic morphological variation. K.H. BERNAL.
35	The 'hole' truth: collateral ligament fossae size and shape and hominoid locomotor adaptations . V.N. BISTREKOVA, J. ACHENJANG, A.S. DEANE.
36	Adaptability within boundaries: support use in two species of <i>Lepilemur</i>. M.L. BLANCHARD, R.H. CROMPTON.
37	Life stages, body proportions and locomotor behavior in captive <i>Pan paniscus</i>. D.R. BOLTER, A.L. ZIHLMAN.
38	Trabecular density in cursorial and non-cursorial limb joints. H. CHIRCHIR, B.G. RICHMOND, C.B. RUFF.
39	Manual phalangeal curvature and its relationship to positional behavior in anthropoids. A.G. CLAXTON, J.H. LANGDON.
40	Relationships between skull size and body mass in primates. M.N. COLEMAN, W.L. JUNGERS.
41	Biomechanical implications on the onset of walking. L.W. COWGILL, R. JOHNSTON.
42	The stability of "Maximum Ingested Bite Size" over time. T.J. CRISTE, A. HARTSTONE-ROSE, E.M. SIMPLER, A.L. HECKLER, J.M. PERRY.
43	Body mass prediction: the accuracy of estimating overweight individuals. S.R. DANESHVARI.
44	Can caudal vertebral body articular surface shape discriminate among prehensile and non-prehensile tailed anthropoids? . A.S. DEANE, J.M. ORGAN, M. MUCHLINSKI.
45	Femoral bone growth and the relationship with stable isotope values: Preliminary results. C.A. DETER, P. MAHONEY.
46	Mandibular bone stiffness in sooty mangabeys. A.C. DUQUE, D.J. DAEGLING, W.S. MCGRAW, J.D. PAMPUSH.
47	Limb bone diaphyseal structure and its mechanical significances in lorisids. N. EGI, M. NAKATSUKASA, N. OGIHARA.
48	Estimating load distribution across the radius and ulna in humans and non-human primates. M.E. ELMER, B.A. PATEL.
49	Swing phase energy storage in the goat fascia lata has implications for the function of the human iliotibial band . C.M. ENG, D.E. LIEBERMAN, A.A. BIEWENER.
50	Toward a more perfect photogrammetry: accurately measuring physical traits of free-ranging animals. J.L. FULLER, S.K. ROBERTS.
51	Geometric morphometric assessment of pelvic sexual dimorphism in <i>Pan</i>, <i>Gorilla</i>, and <i>Homo sapiens</i>. R.R. GRAVES.
52	The mechanical properties of maximum ingested bite size. A. HARTSTONE-ROSE, T.J. CRISTE, K.E. MACNEILL, N.A. YASIKA, L.J. PASSMORE, J.M. PERRY.
53	Limb excursion patterns of an arboreal marsupial (<i>Petaurus breviceps</i>) vary with substrate size and inclination . A.N. HEARD-BOOTH, L.J. SHAPIRO, J.W. YOUNG.

 Friday April 13th, 2012 All Day Poster Sessions

- 54 **The influence of lower limb length and body mass on walking kinematics at the knee and ankle.** M. HORA, L. SOUMAR, K. STRÁŇKOVÁ, T. MICHÁLEK, V. SLÁDEK.
- 55 **Unexpected regional differences in collagen fiber orientation heterogeneity (CFO-Het) between chimpanzee and human proximal femoral shafts: is CFO-Het still a useful characteristic for corroborating load history data?.** K.E. KEENAN, A.M. MILLET, J.G. SKEDROS.
- 56 **Low, sexually-monomorphic digit ratios in a wild strepsirrhine primate (*Microcebus rufus*).** A.D. KEMP, S. ZOHDY, J. JERNVALL.
- 57 **Jaw shape diversity in Platyrrhine 'sclerocarpic Foragers'f.** Z.S. KLUKKERT, T. HARRISON.
- 58 **Drifting osteons seem unlikely to be a mechanical adaptation in view of inconsistent regional distributions and overall low prevalence in adult chimpanzee and human femora.** A.N. KNIGHT, K.E. KEENAN, J.A. HALLEY, J.G. SKEDROS.
- 59 **Bipod lengths during quadrupedal walking in the kinkajou (*Potos flavus*): another step toward understanding the evolution of diagonal-sequence gaits.** V. TOMCEJ, M. CARTMILL, P. LEMELIN.
- 60 **Quantitative histomorphometry of humeral and femoral diaphyses: A longitudinal comparison of osteon population density and primary bone deposition in eight anatomical regions of interest along the bone shaft .** I.S. MAGGIANO, C.M. MAGGIANO, V. TIESLER, S. STOUT.
- 61 **Locomotor characterization of the sub-fossil lemur *Babakotia*.** D. MARCHI, B.A. PATEL, C.B. RUFF, M. HABIB.
- 62 **Unexpected pollex and hallux use in wild *Pongo pygmaeus wurmbii*.** N.K. MCCLURE, A.C. PHILLIPS, E.R. VOGEL, M.W. TOCHERI.
- 63 **Cross-sectional geometry of the mandible in neonatal common marmosets (*Callithrix jacchus*) .** A. MORK, C.J. VINYARD.
- 64 **Hand and foot proportions of the mountain gorilla, *Gorilla beringei beringei*.** K.L. MURTOUGH, S.C. MCFARLIN, A.B. ERIKSEN, A. MUDAKIKWA, M.W. TOCHERI, B.G. RICHMOND.
- 65 **Influences on occipital condyle position in Anthropeidea.** T.K. NALLEY, N.A. GRIDER-POTTER.
- 66 **Functional morphology of the trunk in chimpanzees.** J. NEUFUSS, M.S. FISCHER, S.K. THORPE, N. SCHILLING.
- 67 **Making functional and dietary inferences using FEA: approximations in modelling .** P. O'HIGGINS, M.J. FAGAN, M. PRÔA, L.C. FITTON.
- 68 **Electromyography of pedal and crural muscles in *Cebus apella*: implications for the evolution of the anthropoid grasping foot.** B.A. PATEL, S.G. LARSON, J.T. STERN JR..
- 69 **Anthropoids take smaller bites than strepsirrhines.** J.M. PERRY, A. HARTSTONE-ROSE, M.L. BASTIAN.
- 70 **Locomotor inferences in *Hispanopithecus laietanus* on the basis of its femoral neck cortical thickness.** M. PINA, D.M. ALBA, S. ALMÉCIA, J. FORTUNY, S. MOYÀ-SOLÀ.
- 71 **Integration and hominoid sexual dimorphism.** J.M. POLANSKI.
- 72 **Functionally-related morphometric maps of femoral cortical bone topographic variation: *Homo* vs. *Pan*.** L. PUYMERAIL, L. BONDIOLI, F. MARCHAL, R. MACCHIARELLI.
- 73 **Correlation between elastic modulus and radiographic density in mandibular cortical bone of colobine monkeys.** A.J. RAPOFF, K.C. ABRAHAMSON, S. MCGRAW, A. DUQUE, J.D. PAMPUSH, D.J. DAEGLING.
- 74 **Comparison of *Alouatta* male and female limb bone properties.** J.A. RUNESTAD CONNOUR, K.E. GLANDER.
- 75 **Ontogenetic changes in cortical and trabecular bone in the human femur and tibia.** T.M. RYAN, C.N. SHAW, Z.R. HUBBELL, S.M. SUKHDEO, J.H. GOSMAN.
- 76 **Phylogenetic and locomotor signals in the primate bony pelvis- a multivariate approach.** D. SHAPIRO.
- 77 **Opisthocranium migration: female progenesis in the vervet (*Chlorocebus aethiops*) cranium.** E.A. SIMONS.
- 78 **Ontogenetic shape variation in the cranium of *Rungwecebus kipunji*.** M. SINGLETON.
- 79 **When artiodactyls lead anthropologists astray: important considerations, strengths, and limitations of comparing limb bone adaptation between artiodactyls and primates.** J.G. SKEDROS.
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 Friday April 13th, 2012 All Day Poster Sessions

80	Variation in mandibular condylar morphology in two Taï Forest Colobine species. K. SKORPINSKI, D. DAEGLING, S. MCGRAW.
81	The role of masticatory strain in the phylogenetic utility of cranial datasets in papionin primates . H.F. SMITH, N. VON CRAMON-TAUBADEL.
82	Relative eye size at birth in strepsirrhines and <i>Tarsius</i>: Life history correlates and growth patterns. T.D. SMITH, J.R. CUMMINGS, M.N. MUCHLINSKI, E.C. KIRK, S.J. REHOREK, V.B. DELEON.
83	Does the primate pattern hold up? Testing the functional significance of infraorbital foramen size variation among marsupials . A.N. SPRIGGS, M.N. MUCHLINSKI, A.D. GORDON.
84	Intraskeletal variability of relative cortical area. M.C. STEWART, S.D. STOUT, P.W. SCIULLI.
85	Three dimensional quantification of upper limb bilateral asymmetry among modern humans and great apes. J.T. STOCK, T. DAVIES, L. SARRINGHAUS, C.N. SHAW.
86	<i>In vitro</i> validation of a finite element model of a chimpanzee cranium. D.S. STRAIT, A.L. SMITH, U. ZAPATA, P.C. DECHOW.
87	The primary orientation of trabecular bone in the hominoid tibiotalar joint. A. SU, B. DEMES, K.J. CARLSON.
88	Trabecular bone structure in the forelimb and hindlimb of quadrupedal primates and carnivores. S.M. SUKHDEO, T.M. RYAN.
89	Pelvic sexual dimorphism among species monomorphic in body size: commonalities and relationship to newborn size. R.G. TAGUE.
90	Passive joint motion of the chimpanzee knee, ankle and foot. N.E. THOMPSON, M. O'NEILL, S.G. LARSON, B. UMBERGER.
91	Substrate preferences relation to talo-crural shape: epigenetic and phylogenetic signals during ontogeny. K. TURLEY, S.R. FROST.
92	The scaling of maximum jaw-opening ability in primates. C.J. VINYARD, W.L. HYLANDER.
93	Endostructural conformation and properties of the Neanderthal La Ferrassie 2 tibial plateau. V. VOLPATO, A. BEAUDET, A. MAZURIER, R. MACCHIARELLI.
94	Calcification of osteons in a sample of twentieth century Americans. R.A. WALKER.
95	The utility of anterior femoral curvature as an indicator of mobility. K.D. WALLER, R.Y. YIM, L.W. COWGILL.
96	Sensitivity of nonlinear elastic properties of zygomaticotemporal sutures in a macaque cranial Finite Element Model . Q. WANG, I.R. GROSSE, B.W. WRIGHT, C.D. BYRON, D.S. STRAIT.
97	Hip abductor force production as a contributor to locomotor cost. A.G. WARRENER.
98	Hanging by a limb: Using non-invasive methods to evaluate ontogenetic changes in muscle mass in the limbs of a <i>Lagothrix lagotricha</i>. K. WHITE, J. ACHENJANG, G. JONES, J.M. ORGAN, M. MUCHLINSKI, A.S. DEANE.
99	<i>In silico</i> comparisons of craniofacial biomechanics in platyrrhine and strepsirrhine destructive and extractive foragers to determine the diet and ingestive behavior of the subfossil <i>Archaeolemur</i>. B.W. WRIGHT, L.R. GODFREY, D. PULASKI, A. HELLER, I.R. GROSSE, E.R. DUMONT.
100	Morphological diversity among tufted capuchins . K.A. WRIGHT, B.W. WRIGHT, S. FORD, T.J. MASTERSON, JR., D. HOBBS, J.W. LYNCH ALFARO.
101	Variation in plantar pressure distribution in habitually unshod humans. R.E. WUNDERLICH, K.G. HATALA, H.L. DINGWALL, B.G. RICHMOND.
102	Profiling primates: anatomical methods for data collection, analysis, and comparison. A. ZIHLMAN, C. UNDERWOOD.

 Friday April 13th, 2012 All Day Poster Sessions

Session	HUMAN AND NON-HUMAN PRIMATE TEETH. Contributed Posters. Plaza Level.
17	Chair: Brian Hemphill
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
103	Presentation Withdrawn
104	The development of the maxillary dentition in newborn strepsirrhine primates. W.R. BUCHER, V.B. DELEON, J.W. YOUNG, C.J. VINYARD, T.D. SMITH.
105	Postcanine tooth size in anthropoid primates in relation to dietary behavior. M. BURGESS.
106	Are root dimensions linked to mandibular robusticity in the common chimpanzee (<i>Pan troglodytes verus</i>)?. M. BÄUCHLE, K. KUPCZIK, P. GUNZ, O. KULLMER, J. HUBLIN.
107	Dental microwear texture analysis of Bronze and Iron Age Agriculturalists from England. L.W. CHIU, C.W. SCHMIDT, P. MAHONEY, J.I. MCKINLEY.
108	Population continuity or replacement at ancient Lachish? A dental affinity analysis in the Levant. C.R. DICKE-TOUPIN, J.D. IRISH.
109	Within population variation: postnatal dental development in the Southeastern US. M.A. DOTSON, E.H. KIMMERLE, L.W. KONIGSBERG.
110	Trigonid talonid height and dental shearing in a sample of euprimates . L.A. GONZALES, S.B. COOKE.
111	An odontometric investigation of the biological origins of the Baltis: a Tibeto-Burman speaking population of Northern Pakistan . M. GUZMAN, B.E. HEMPHILL.
112	Linear enamel hypoplasias as stress indicators to interpret the effects of urbanization in the Iberian Peninsula. A.R. HALE, A.H. ROSS.
113	The dog days of stress: a comparison of methods for determining age at occurrence of enamel hypoplasias . A.R. HARVEY.
114	Dental eruption sequences in strepsirrhines. L.M. HAWKINS, E.H. GUTHRIE, S. FROST.
115	The Awans of northern Pakistan—emigrants from Central Asia, Arabs from western Afghanistan, or colonists from peninsular India?: a dental morphometric investigation. B. HEMPHILL.
116	Dental morphological analysis of two Portuguese Neolithic samples. B.C. HORWATH, J.D. IRISH.
117	Population continuity after all? potential late Pleistocene dental ancestors of Holocene Nubians have been found!. J.D. IRISH.
118	Postcanine tooth size and metabolic requirements in primates. P. PALMQVIST, J. JIMÉNEZ ARENAS, J. PÉREZ-CLAROS.
119	A case of nasal teeth from the Middle Horizon Tiwanaku site of Chen Chen M1 in the Moquegua Valley, Peru. K.M. JOHNSON.
120	Revisiting dental age assessments in wild and captive <i>Pan</i>: new analyses of classic data. K.L. KUYKENDALL, J. BOUGHNER, C. DEAN.
121	Odontological characteristics of the craniological series from the Bol'shoi Olen'ii island in Barents Sea: new data on Eastern impulse in Saami ethnogenesis. N.A. LEYBOVA.
122	Incremental enamel development in modern human deciduous teeth. P. MAHONEY.
123	Enamel thickness and hard-object feeding in mangabeys. W.S. MCGRAW, J. PAMPUSH, D. DAEGLING.

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124	Microstructural analysis of linear enamel hypoplasia and estimation of stress episode duration in Jomon period dental remains from Hokkaido with comparisons to other cold-adapted foragers. J. MCGROARTY, D.H. TEMPLE, D. GUATELLI-STEINBERG, M. NAKATSUKASA, H. MATSUMURA.
125	Metameric variation in the expression of the interconulus in <i>Papio</i> and <i>Macaca</i>. T. MONSON, L. HLUSKO.
126	The Patterning Cascade Model and expression of the Carabelli feature in humans: differences between first and second molars and correlation with other dental traits. S.M. MOORMANN, D. GUATELLI-STEINBERG, J.P. HUNTER.
127	Influential variables on osseous tooth socket healing time. J. MORGAN.
128	Odontometric variation among three ethno-linguistic groups from the rugged mountain highlands of Gilgit-Baltistan, Pakistan: testing historical hypotheses with tooth size allocation analysis. P.W. O'NEILL, B.E. HEMPHILL.
129	Secondary ritual or peri-mortem body manipulation during early Holocene in South America: the case of Burial 21 from the site of Lapa do Santo, Lagoa Santa region, Brazil. R.E. OLIVEIRA, A.M. STRAUSS, P.T. DA GLORIA, D.V. BERNARDO, R. KIPNIS, W.A. NEVES.
130	Hardness testing of primate dentine. J.D. PAMPUSH, A.C. DUQUE, D.J. DAEGLING, W.S. MCGRAW.
131	Geometric morphometric analysis of the upper first molar in modern hunter-gatherer populations. A. ROMERO, F.V. RAMIREZ ROZZI, M. ARTERO, S. TORRIJO, N. LÓPEZ, J. DE JUAN, A. PÉREZ-PÉREZ.
132	An analysis of methods and importance of interobserver error in odontometric studies. K.Z. RUDOLPH, A.R. THOMPSON.
133	Mandibular premolar morphology is correlated with dietary toughness in sympatric callitrichids. K. SCHROER, L. PORTER, P. GARBER, B. WOOD.
134	Determining sources of dental microwear texture variation in anthropoids. A.E. SHAPIRO.
135	Investigation of dental metric and morphological patterns associated with expression of the Uto-Aztec premolar. A.R. THOMPSON.
136	Enamel thickness in <i>Microcebus murinus</i> and <i>Macaca mulatta</i> and the evolutionary genetics of enamel matrix proteins in hominoids. J.E. HORVATH, C. WU, M. TOLER, O. FEDRIGO, L.W. PFEFFERLE, A. MOORE, G.L. RAMACHANDRAN, C.C. BABBITT, J. JERNVALL, G.A. WRAY, C.E. WALL.
137	Dental evidence on the origins of the Irish. J.D. WEETS, B.M. USHER.
138	Does the delivery mode influence enamel neonatal line thickness variation?. C. ZANOLLI, L. BONDIOLI, F. MANNI, P. ROSSI, R. MACCHIARELLI.
Session 18	PRIMATOLOGY. Contributed Posters. Plaza Level. Chair: Michael P. Muehlenbein
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
139	A preliminary report on the behavioral ecology of bald-faced saki monkeys (<i>Pithecia irrorata</i>) in southeastern Perú. D.B. ADAMS.
140	A lethal case of malignant lymphoma in a wild squirrel monkey (<i>Saimiri boliviensis</i>) in the Peruvian Amazon. R. PITMAN, D.B. ADAMS, M. WATSA.
141	Vegetation diversity and habitat heterogeneity: implications for chimpanzee feeding ecology across Kibale National Park, Uganda. G.P. ARONSEN, K.B. POTTS, S. TELEN.
142	Long calls produced by male, Bornean orang-utans (<i>Pongo pygmaeus wurmbii</i>) advertise individual identity, context and an individual's future direction of travel. J.A. ASKEW, H.C. MORROGH-BERNARD.
143	Lions and tigers and humans, oh my! Including human predation of primates in primate behavioral ecology. K.H. BANNAR-MARTIN.

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- 144 **Sleeping site selection in the Bolivian gray titi monkey, *Callicebus donacophilus*.** K.P. BANTA, M.J. SELVIG, K. DINGESS.
- 145 **An examination of micronutrient content of selected Tana River Primate National Reserve, Kenya, yellow baboon (*Papio cynocephalus*) foods.** V.K. BENTLEY-CONDIT, M.L. POWER.
- 146 **Stable isotope data for monkeys of the Ivory Coast's Tai Forest.** M.H. BERGER, J.S. KRIGBAUM, D.J. DA EGLING, W. MCGRAW.
- 147 **Integrating the stable isotope and nutritional ecology of an East African forest.** S.A. BLUMENTHAL, K.L. CHRITZ, T.E. CERLING, J.M. ROTHMAN.
- 148 **Invertebrates provide substantial energy and protein for redtail monkeys (*Cercopithecus ascanius*) in Uganda.** M.A. BRYER, D. RAUBENHEIMER, C.A. CHAPMAN, J. M. ROTHMAN.
- 149 **Population assessment of Demidoff's dwarf galago (*Galagoides demidovii*) in a Ghanaian forest fragment mosaic.** F.A. CAMPOS, E.C. WIKBERG, T.D. HOLMES.
- 150 **Chimpanzee consumptive behavior associated with diurnal nutrient cycling.** B.A. CARLSON, J.C. MITANI.
- 151 **Examination of female dyadic relationships in flexible social grouping of captive orangutans.** A.L. CARNER, S.E. REISBERG, A.E. BANIA.
- 152 **Fecal bacterial diversity of the wild mantled howling monkey (*Alouatta palliata*).** J.B. CLAYTON, H. KIM, K.E. GLANDER, R.E. ISAACSON, T.J. JOHNSON.
- 153 **Dominance in male mantled howlers (*Alouatta palliata*): association with age, immigration patterns and group history in two social groups at Hacienda La Pacifica, Costa Rica.** L.C. COREWYN, M.R. CLARKE.
- 154 **Quantifying edge effects using stable isotopes.** B.E. CROWLEY, K. MCGOOGAN, S.M. LEHMAN.
- 155 **Female dominance and feeding behavior in Verreaux's sifaka in the Kirindy Mitea National Park.** S.J. CRYSTAL, R.J. LEWIS.
- 156 **Ecological and behavioral analyses of the *Cercopithecus* hybrid population at Gombe National Park, Tanzania.** K.M. DETWILER.
- 157 **Effects of anthropogenic habitat disturbance on the distribution of the diurnal primate community in northwestern Bolivia: using census and remote sensing techniques.** I.I. DIAZ.
- 158 **Co-evolution of facial expressivity and cooperation in catarrhine primates.** S.D. DOBSON.
- 159 **Assessing farm risk to crop damage by vervet monkeys (*Chlorocebus aethiops*) in St. Kitts, West Indies.** K.M. DORE.
- 160 **Paternal infanticide in the socially monogamous Bolivian gray titi monkey, *Callicebus donacophilus*.** K.A. DINGESS, A. DOUBLEDAY.
- 161 **Do female brown capuchin monkeys use affiliative behavior to mediate stress?.** E.E. EHMKE, S. BOINSKI.
- 162 **Glottal pop vocalizations in mantled howler monkeys (*Alouatta palliata*) facilitate and predict the direction of group travel.** K.M. ELLIS, M.E. HOPKINS.
- 163 **Variation in muscle mass in wild chimpanzees: application of a modified urinary creatinine method.** M. EMERY THOMPSON, M.N. MULLER, E. FITZGERALD, R.W. WRANGHAM.
- 164 **Rhesus macaques (*Macaca mulatta*) use snake postures to identify intensity of threat.** S.F. ETING, L.A. ISBELL.
- 165 **Feeding ecology of wild geladas (*Theropithecus gelada*) over an annual cycle at Guassa, Ethiopia.** P.J. FASHING, N. NGUYEN, J.T. KERBY, V.V. VENKATARAMAN.
- 166 **Sexual swellings of wild Sanje mangabeys (*Cercocebus sanjei*) in the Udzungwa Mountains of Tanzania.** D. FERNÁNDEZ.
- 167 **Differences in activity patterns between mouse lemurs (*Microcebus griseorufus*) in protected and human-disturbed forests in the Beza Mahafaly Special Reserve, Madagascar.** K. FISH, J. SODOWSKY, K. BRESLIN, L. BROUDY, S. SOFFER, R. ANJARASOANIANA.
- 168 **Fallback food consumption and sympatry in *Eulemur coronatus* and *Eulemur sanfordi*.** B.Z. FREED.
- 169 **Population health in fragmented forests: dry season variations in stress and parasitism in the *Lemur catta* of Madagascar's central highlands.** D.N. GABRIEL, L. GOULD.

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- 170 **Ecological effects on sexual dimorphism: Sex-specific body mass response to climate variables in wild populations of eastern sifakas.** A.D. GORDON, S.E. JOHNSON, E.E. LOUIS, JR.
- 171 **Do acoustics determine group-specific vocalizations? Effects of environmental acoustics on the infant vocalizations of two populations of *Cebus capucinus*.** A.R. HALLORAN, S. MANCZ.
- 172 **The role of female choice in male rank relationships and length of group membership in a captive group of rhesus macaques (*Macaca mulatta*).** D.L. HANNIBAL, S.K. SEIL, M.E. JACKSON, K.P. BANTA, B.A. BEISNER, B. MCCOWAN.
- 173 **Biogeographic causes of speciation for lemurs in Madagascar.** J.P. HERRERA.
- 174 **Building a GIS geodatabase to aid in black howler monkey (*Alouatta pigra*) conservation management strategies.** A.L. HURST.
- 175 **Application of human-based sensory integration therapy for improving the well-being of a captive chimpanzee (*Pan troglodytes*).** E.J. INGMANSON, T.A. MAY-BENSON, S. BRACCINI, I. PORTON, T. HUNNICUTT, M.L. BAUMAN.
- 176 **Nutritional composition of foods eaten by chacma baboons in the Tokai Forest of the Cape Peninsula, South Africa.** C.A. JOHNSON, D. CLARKE, B. REBEIRO, J.M. ROTHMAN, L. SWEDELL.
- 177 **Influence of association with red colobus (*Procolobus badius*) on the feeding ecology of Diana monkeys (*Cercopithecus diana*) in the Ivory Coast's Tai Forest.** E.E. KANE, E.A. BITTY, W.S. MCGRAW.
- 178 **Manual graminivory and feeding rates in gelada baboons.** J.T. KERBY, V.V. VENKATARAMAN, P.J. FASHING, N. NGUYEN.
- 179 **Field-testing global positioning system (GPS) collars on long-tailed macaques (*Macaca fascicularis*) in Singapore: evaluation of tracking ability in mixed rainforest habitat.** A.R. KLEGARTH, A. FUENTES, H. HOLLOCHER.
- 180 **Exploring the differences in how long-tailed macaques (*Macaca fascicularis*) exploit human-modified environments: Do age and sex matter?** A.C. KWIATT, T.Q. BARTLETT, A. FUENTES.
- 181 **CAUGHT in the act: nighttime activity in *Lemur catta*.** M. LAFLEUR.
- 182 **Nutritional and energetic correlates of cheek pouch use in Cercopithecinae: implications for interpreting the role of feeding competition in the selection of diet-related morphology and food processing behavior.** J.E. LAMBERT, J.M. ROTHMAN.
- 183 **Model selection, zero-inflated models, and predictors of primate abundance in Cameroon.** R.R. LAWLER, J.M. LINDER.
- 184 **Diet and food availability of Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) in Khau Ca area of Ha Giang Province, Vietnam.** Q.K. LE, H.H. COVERT, D.A. NGUYEN.
- 185 **Demographic and social influences on ectoparasite transmission in wild Verreaux's sifaka (*Propithecus verreauxi*).** R.J. LEWIS, D. CAILLAUD, L.A. MEYERS.
- 186 **Differences between black howler (*Alouatta pigra*) group size and pattern of vocalization in two ecologically different populations in northern Belize.** S.J. LICHTENBERG, J. SIMMONS, B. BENEFIT, F. MCCROSSIN, T. KAUTZ, I. ARNEY, L.C. DIAZ, M. DIAZ, R. DIAZ, R. MILNE, B. SHENDO.
- 187 **The anatomy of an oil palm plantation and why African primate diversity is in trouble.** J.M. LINDER, L. GORSCHLÜTER, S. ALTHERR, A.I. CHAPPLE, C. ASTARAS.
- 188 **Geographic variation in hair $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of vervet monkeys (*Chlorocebus aethiops*) reflect anthropogenic impact.** J.E. LOUDON, T.R. TURNER, J.P. GROBLER, K.L. MOYER, R.C. WALKER, M. SPONHEIMER.
- 189 **Diet of the black howler monkey (*Alouatta pigra*) in mangrove and the phytochemistry of mangrove plants.** L. LUECKE-BRIDGEMAN.
- 190 **Group size and social flexibility among pair-bonded primates.** A. MACLENNAN, T. GUTIERREZ, T.Q. BARTLETT.
- 191 **Influences of natural and anthropogenic landscape features on ranging patterns of white-faced capuchins (*Cebus capucinus*).** E.K. MALLOTT.
- 192 **Promiscuous mating with an aggregation of males by a female black handed spider monkey (*Ateles geoffroyi*) in northern Belize.** L.C. DIAZ, I.D. ARNEY, S. LICHTENBERG, J. SIMMONS, R. DIAZ, B. SHENDO, R. MILNE, F. MCCROSSIN, T. KAUTZ, M. DIAZ, B. BENEFIT, M.L. MCCROSSIN.

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193	Causal mechanisms of the development of scent-marking in <i>Lemur catta</i>: inferences from comparison of wild and captive settings. S.L. MEREDITH.
194	Fecal glucocorticoid responses in wild orangutans following human visitation. M.P. MUEHLENBEIN, M. ANCRENAZ, R. SAKONG, L. AMBU, S. PRALL, G. FULLER, M. RAGHANTI.
195	Primates as predictors of mammal community richness in the forest ecosystems of Madagascar. K.M. MULDOON, S.M. GOODMAN.
196	Variation in 2D:4D between captive and free-ranging primates: implications for digit ratio research. E. NELSON, M.H. MCINTYRE, M. RAKHOVSKAYA, V. WOBBER, E. HERRMANN, B. HARE.
197	Bachelor gelada association and ranging patterns: implications for multi-level societies. D.J. PAPPANO, J.C. BEEHNER.
198	Human dimensions of primate conservation, with a focus on field work with Neotropical Primate Conservation in Peru. E.A. PATTON.
199	Correlates of post-conflict affiliation in captive bonobos. B. PETERSON.
200	Coping strategies of a disabled female <i>Propithecus verreauxi</i> at the Beza Mahafaly Special Reserve, Madagascar. J.J. PYLE.
201	The effect of age on gestural communication in captive bonobos. E.M. QUIGLEY, L.F. MARCHANT.
202	Hearing sensitivity and the evolution of acoustic communication in platyrrhine monkeys. M. RAMSIER, A.J. CUNNINGHAM, M. PATIÑO, F.A. VILLANEVA, F. SPOOR, B. DEMES, S. LARSON, K.E. GLANDER, M. TALEBI, N.J. DOMINY.
203	Intraspecific variability in tannin contents of tree leaves consumed by colobus monkeys (<i>Colobus guereza</i> and <i>Procolobus rufomitratus</i>) in Kibale National Park, Uganda. S. RAVI, C. CULMA, J.M. ROTHMAN.
204	Lemur movement pattern and its implications for seed distribution. O.H. RAZAFINDRATSIMA, T.A. JONES, A.E. DUNHAM.
205	Conservation in a sacred forest: An integrated approach for assessing the long-term conservation potential of Javan gibbons (<i>Hylobates moloch</i>) in a human-impacted forest. M.A. REISLAND, J.E. LAMBERT.
206	The Bruce effect in a wild primate. E.K. ROBERTS, A. LU, T.J. BERGMAN, J.C. BEEHNER.
207	Cortisol and reproductive state in female black-handed spider monkeys. M.A. RODRIGUES, D.M. KITCHEN.
208	A comparison of methods for studying elusive savanna chimpanzees at Ugalla, Tanzania. S.M. RUSSAK, F.A. STEWART, A.K. PIEL.
209	Climatic effects on wild ring-tailed lemur biomedical values at the Beza Mahafaly Special Reserve, Madagascar . M.L. SAUTHER, F.P. CUOZZO, R. LARSEN, A. MORESCO, A. NORRIS, A. SIMAI, C. SINGLETON, A. SMITH, G.F. STEGMANN, M. WEBER, I. JACKY YOUSOUF.
210	Sex-typing in juvenile male and female ring-tailed lemurs . A.L. SCHREIER, N.L. BARRICKMAN, S. GUPTA.
211	Sex-based differences in the positional behavior of Lowe's guenons and ursine colobus in Boabeng Fiema Monkey Sanctuary, Ghana. R.L. SCHUBERT.
212	The effect of female preference on male integration in a captive rhesus macaque social group (<i>Macaca mulatta</i>). S.K. SEIL, M.E. JACKSON, D.L. HANNIBAL, K.P. BANTA, B.A. BEISNER, B. MCCOWAN.
213	Play behavior in captive black crested mangabeys (<i>Lophocebus aterrimus</i>). N.P. SHANLEY, K.L. GRAHAM.
214	Is there an environmental effect on acoustic strategies of black and white ruffed lemurs (<i>Varecia variegata editorum</i>) in Ranomafana National Park, Madagascar?. B. SINGLETARY, J.P. HERRERA, S. TECOT.
215	The relationship between gestural signaling and positional behavior in chimpanzees and bonobos. L.W. SMITH.
216	Ranging patterns of red langurs (<i>Presbytis rubicunda</i>) in East Kalimantan, Indonesia. S.N. SPEHAR, R.A. DELGADO.
217	Linking GPS data with behavior to study the travel ecology of the Japanese macaques of Yakushima Island, Japan. D.S. SPRAGUE, M. NISHIKAWA.

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218	The Multiple Travel Paths method: a new method for estimating daily travel distance in arboreal, group-living primates. R.I. STEEL.
219	Impact of tourism on the behavior of red howler monkeys in Suriname. J.L. WESTIN.
220	Feeding competition and stress in wild tufted capuchin monkeys: implications for the evolution of deceptive alarm calls. B.C. WHEELER, B. TIDDI, M. HEISTERMANN.
221	Wet season dietary comparisons of <i>Lemur catta</i> populations in southwestern Madagascar. N. YAMASHITA, M.L. SAUTHER, F.P. CUOZZO, M. LAFLEUR.

Friday. Morning Sessions.

Session 19	PRIMATE FUNCTIONAL ANATOMY AND LOCOMOTOR BEHAVIOR. Contributed Podium Presentations. <i>Galleria North</i>. Chair: Jesse W. Young
8:00-8:15	Ecomorphology in a phylogenetic statistical context: a case study using the bovid femur. W. BARR.
8:15-8:30	Swing phase period in primates and other mammals: influences of speed and limb design. C.E. MILLER, P. LEMELIN, D. SCHMITT.
8:30-8:45	Evolutionary implications of quadrupedal locomotor mechanics in cotton-top tamarins (<i>Saguinus oedipus</i>). J.W. YOUNG, C.D. FELLMANN.
8:45-9:00	Osteonal bone density in the mandibles of West African colobines. D.J. DAEGLING, W.S. MCGRAW.
9:00-9:15	Stable thoracolumbar morphology: implications for terminal branch locomotion. M.C. GRANATOSKY, P. LEMELIN, J.B. HANNA, S.G. CHESTER, D. SCHMITT.
9:15-9:30	Ontogeny of the catarrhine shoulder: the influence of behavior on morphology. D.J. GREEN.
9:30-9:45	How well does endocranial morphology predict behavioral differences in primates?. D.R. HURST, P. SCHOENEMANN, M.M. LOYET, B.B. AVANTS, J.C. GEE.
9:45-10:00	Internal bone structure of the last sacral vertebral body and its relationship to tail length. G.A. RUSSO, R.J. FAJARDO, J.E. SCHMITZ.
10:00-10:15	Comparative first metatarsal head trabecular bone ontogeny in African apes and humans . A. ZEININGER.
10:15-10:30	Break
10:30-10:45	Associations between skeletal fractures and locomotor behavior, habitat use, and body mass in nonhuman primates. H. JARRELL.
10:45-11:00	Great ape virtopsy as a tool for musculoskeletal structure-function analysis . N. MORIMOTO, M.S. PONCE DE LEÓN, T. NISHIMURA, C.P. ZOLLIKOFER.
11:00-11:15	Primate cranial diversity: comparisons among the major primate radiations contradict larger and more general trends. J.G. FLEAGLE, C.C. GILBERT, A.L. BADEN.
11:15-11:30	How to distinguish and analyse locomotor groups in the Hominoidea: analysis of supraspinous and infraspinous fossae with geometric morphometrics, 3D laser scanning and new methodologies to measure muscle mass. G. BELLO-HELLEGOUARCH, J.M. POTAU, J. ARIAS-MARTORELL, A.M. PÉREZ-PÉREZ.
11:30-11:45	Ontogenetic diaphyseal shape correspondences in the human lower limb. A. GALLAGHER.
11:45-12:00	Epaxial muscle function in walking and running humans. N. SCHILLING, D.R. CARRIER, C. ANDERS.

 Friday April 13th, 2012 Morning Sessions

Session 20	<p>NOT BY BREAD ALONE: NON-CALORIC DETERMINANTS OF LIFE HISTORY STRATEGIES. CO-SPONSORED BY THE HUMAN BIOLOGY ASSOCIATION AND THE AAPA. Invited Podium Symposium. <i>Galleria South.</i></p> <p>Chairs: Virginia J. Vitzthum and Pablo Nepomnaschy</p> <p>The role of energetics as a modulator of life history trajectories (e.g., the timing of developmental milestones and reproductive events, and the amount of effort invested in each reproductive venture) has garnered much attention from biological anthropologists. However, both life history theory and a growing body of empirical evidence suggest that factors not directly related to energy availability (e.g., mortality schedules, social dynamics, genotypes) can also play central roles in shaping life history strategies (LHS) in humans and other primates. In this symposium speakers will examine both ultimate and proximate determinants of LHS and the mechanisms by which they contribute to variation in LHS. Talks will explore how genotypic variation, immune challenges, temporal changes in the cross-talk between the HPA and HPG axes, and the social milieu affect ontogenetic trajectories and impact life history trade-offs, thereby creating variation in life history trajectories and reproductive strategies. The symposium is intended to stimulate more research that contributes to developing a comprehensive understanding of the interplay of the various determinants of LHS in humans and other primates.</p> <p>Chair: Pablo Nepomnaschy</p>
8:00-8:15	Ecological influences on primate maternal investment strategies. B.S. LOW, A. HAZEL, P. NEPOMNASCHY.
8:15-8:30	Immune and reproductive functions in female life history: how do we go about it?. A. NUNEZ-DE LA MORA.
8:30-8:45	A Vandenberg effect in wild geladas?. A.P. LU, J.C. BEEHNER.
8:45-9:00	Childhood milk consumption and age at menarche in NHANES: A role for IGF-I?. A.S. WILEY.
9:00-9:15	Developmental stress, reproductive development and adult body size: a life history perspective. D.A. COALL, J.S. CHISHOLM.
9:15-9:30	Correlates of early reproduction in the Dogon of Mali. B.I. STRASSMANN.
9:30-9:45	Is genetic variation a source of individual and populational differences in ovarian hormone concentrations?. V.J. VITZTHUM, J.L. RENBARGER, K.P. NEPHEW, L. LI, J. THORNBURG, S.R. WILLIAMS, T. DESCHNER.
9:45-10:00	Break
	Chair: Virginia J. Vitzthum
10:00-10:15	Potential influences of infant sleeping arrangement (social or solitary) in the developmental trajectories and life history strategy of adults. J.J. MCKENNA.
10:15-10:30	Tobacco, cannabis, parasites, and life history strategies in hunter-gatherers from the Central African Republic. C.J. ROULETTE, E.H. HAGEN.
10:30-10:45	Today is the tomorrow we worried about yesterday: changes in stress axis function across women's reproductive transitions. P.A. NEPOMNASCHY, K.G. SALVANTE, Y. CHEN, L. ZENG.
10:45-11:00	From the womb to the tomb: the role of transfers in shaping the evolved human life history. M.D. GURVEN.
11:00-11:15	Environmental risk and facultative adjustment of life history strategy in the Philippines. J.M. BRAGG, T.W. MCDADE, C.W. KUZAWA.
11:15-11:30	Environmental risk, perceived mortality risk, and facultative adjustment of life history strategy among young adults in the United States. T.W. MCDADE, J. BRAGG, C. KUZAWA, L. CHYU, E.K. ADAM.
11:30-11:45	The timing of the onset and duration of perimenopause in baboons and humans. K.A. O'CONNOR, N. NERETTI, A. BRONIKOWSKI, D.J. HOLMAN, M. TATAR.
11:45-12:00	Hormonal aspects of human and chimpanzee aging. K. HAWKES, J.K. BLEVINS.

Friday April 13th, 2012 Morning Sessions

Session 21	PALEOANTHROPOLOGY: EARLY <i>HOMO</i> . Contributed Podium Presentations. <i>Grand Ballroom II</i> . Chair: John Kappelman
8:00-8:15	eFossils.org: a collaborative website and community database for the study of human evolution. J. KAPPELMAN, P. KEANE, D. REED, J. TENBARGE, A.P. WITZEL, W. BARR, B.A. NACHMAN, G.A. RUSSO.
8:15-8:30	Miocene-to-Recent evolution of the hominin foramen magnum. G.D. RICHARDS, R.S. JABBOUR, C.L. IBARRA, C.F. HORTON, H. ASADI.
8:30-8:45	The „gray ceiling“: why apes are not as large-brained as humans. K. ISLER, J.T. VAN WOERDEN, A.F. NAVARRETE, C.P. VAN SCHAİK.
8:45-9:00	The effect of biacetabular breadth on metabolic cost of human walking and running. K.L. LEWTON, J. LAGRECA, D.E. LIEBERMAN.
9:00-9:15	Understanding footprints: intra-trail variability and its causes. S.A. MORSE, R.H. CROMPTON, M.R. BENNETT.
9:15-9:30	An experimentally-based interpretation of 1.5 million-year-old fossil hominin footprints: Implications for the evolution of human foot function. K.G. HATALA, H.L. DINGWALL, R.E. WUNDERLICH, B.G. RICHMOND.
9:30-9:45	Mandibular variation in early <i>Homo</i> and <i>Au. sediba</i>. L. SCHROEDER, K. CARLSON, D.J. DE RUITER, R.R. ACKERMANN.
9:45-10:00	Manual pressure distribution during stone tool use. E.S. WILLIAMS, B.G. RICHMOND.
10:00-10:15	Stature and speed estimates for 1.5 million-year-old fossil footprints at Ileret, Kenya based on gait analyses of unshod Daasanach. H.L. DINGWALL, K.G. HATALA, R.E. WUNDERLICH, B.G. RICHMOND.
10:15-10:30	Break
10:30-10:45	Traumatic spinal injury in the KNM-WT 15000 <i>Homo erectus</i> skeleton. M. HAEUSLER.
10:45-11:00	Derived anatomy of the shoulder and wrist enable throwing ability in <i>Homo</i>. N.T. ROACH, D.E. LIEBERMAN.
11:00-11:15	Size and skeletal development in early <i>Homo erectus</i>: a comparison of Nariokotome and Dmanisi. A.P. VAN ARSDALE, Z.D. COFRAN, A. PAPAKYRIKOS.
11:15-11:30	Reassessing enigmatic Asian Hominoid dental remains . T.M. SMITH, A. HOUSSAYE, J. HUBLIN, A. KATO, O. KULLMER, E. MAIRE, A.J. OLEJNICZAK, F. SCHRENK, P. TAFFOREAU, J. DE VOS, J.P. ZERMENO.
11:30-11:45	Brain morphology of Zhoukoudian <i>H. erectus</i> . X. WU, L.A. SCHEPARTZ.
11:45-12:00	New perspective on the evolution of infectious disease. L. VAN BLERKOM.
Session 22	HUMAN SKELETAL BIOLOGY: FORENSICS AND BIOARCHAEOLOGY. Contributed Podium Presentations. <i>Parlors</i> . Chair: Charlotte A. Roberts
8:00-8:15	The utility of osteon shape and circularity for differentiating human and nonhuman Haversian bone. V.M. DOMINGUEZ, C.M. CROWDER.
8:15-8:30	Nuclear Magnetic Resonance of bone: a new method for investigation in anthropology? . V. URZEL, Y. SCHULIAR, A. GRÉLARD, C. COURRÈGES, E.J. DUFOURC, H. DUDAY.
8:30-8:45	Intra-tooth stable isotope analysis of human dental tissues: laser ablation of enamel and serial sections of dentine collagen in permanent first molars and canines. P. SANDBERG, B. PASSEY, J. LEE-THORP, M. SPONHEIMER, P. DITCHFIELD, D. VAN GERVEN.
8:45-9:00	Overall health and the pathophysiology of tertiary syphilis. M.K. ZUCKERMAN, G.J. ARMELAGOS.
9:00-9:15	Regional patterns of health in early medieval Ireland: Distributions of non specific stress indicators . M.L. TESORIERI.
9:15-9:30	Understanding re-emerging infectious diseases: contributions on tuberculosis from palaeopathology and biomolecular science. C.A. ROBERTS, A. BOUWMAN, R. MULLER, T. BROWN, S. BUNNING.
9:30-9:45	Quantifying morbidity and quality of life in the Prehispanic Southwest. A.L. STODDER.

 Friday April 13th, 2012 Morning Sessions

9:45-10:00	The shape of the spinal canal and Schmorl's Nodes: two-dimensional shape analysis of lower thoracic vertebrae. K.A. PLOMP, U. STRAND-VIDARSDOTTIR, C.A. ROBERTS.
10:00-10:15	Break
10:15-10:30	The potential of entheses for estimating age. T. TICHNELL.
10:30-10:45	Weaning, age identities and embodiment in the South Central Andes: a preliminary paleodietary investigation using carbon and oxygen stable isotope analysis . A.C. DAHLSTEDT, D.E. BLOM, K.J. KNUDSON.
10:45-11:00	Optimal trait scoring for age estimation. L.W. KONIGSBERG, S.R. FRANKENBERG.
11:00-11:15	The utility of latent class analysis to estimate sex for populations of human skeletal remains. N.V. PASSALACQUA, Z. ZHANG, S.J. PIERCE.
11:15-11:30	An examination of the agreement between genetic and dental reconstructions of biological distance among regional populations . A.R. HUBBARD, D. GUATELLI-STEINBERG, P.W. SCIULLI, P.A. FUERST.
11:30-11:45	The application of the geometric mean in forensic analysis as demonstrated using the talus and calcaneus. D. AGOADA, J.M. DESILVA.
11:45-12:00	Craniofacial variation among West African populations. M.A. POPE, M.L. TISE, E.H. KIMMERLE, A.C. RIVARA.
Session 23	FROM THE COLLAGEN UP: A LOOK AT SCURVY PAST AND PRESENT. Invited Poster Symposium. <i>Forum Suite.</i> Chair: Robert Stark and John Crandall
	7:30-8:00 am Poster set-up 11:00-11:30 am Poster take-down
	The paleopathological study of scurvy has seen increasing attention in recent days. The developing trend of assessing for scurvy when examining skeletal samples has allowed for insights to the lives and dietary difficulties of past populations in a unique and previously underrepresented manner. The novel examination of scurvy has allowed for the development of a plethora of new and innovative methods and techniques for assessing the impact of this metabolic disorder in past populations. This symposium will seek to provide a holistic synthesis of the various current approaches to investigating this disorder in the past through the examination of macroscopic, radiographic, molecular, nutritional, clinical and historic perspectives on scurvy in the hope that a greater consensus and directions for future research can be put forth for looking at scurvy among past populations.
1	Beyond treponematosi: differential diagnosis of the Garbacon Creek ossuary. A.S. ANDERSON.
2	A digital radiographic and macroscopic study of scurvy and treponematoses in Algonkian juvenile remains from the ossuaries of the northern coastal plain of North Carolina. J.C. ARNETT.
3	Was juvenile scurvy endemic to Butrint, Albania during the Middle Ages?. J.S. BEATRICE, C.V. HURST, T.W. FENTON.
4	Complications of co-morbidities: picking out skeletal indicators of scurvy. M.B. BRICKLEY.
5	Pretos Novos: in search for signs of adult scurvy in the slave trade to Brazil, 1769-1830. D.C. Cook, Indiana University'. D.C. COOK.
6	A macroscopic analysis of infantile scurvy from Zape, Mexico (AD 600-1430) . J.J. CRANDALL, D.L. MARTIN, J.L. THOMPSON.
7	A Biochemical marker for scurvy in archaeological bones . H.E. KOON.
8	What can radiology contribute to paleopathological examinations of juvenile scurvy?. R.J. STARK, S. GARVIE-LOK.
9	Discussant, D. ORTNER.

AAPA Luncheon The Perils of Being Bipedal. Delivered by Bruce Latimer.
12:00-2:00 pm. *Grand Ballroom I.*

Friday April 13th, 2012 Afternoon Sessions**Friday. Afternoon Sessions**

Session 24	REPRODUCTION/LIFE HISTORY. Contributed Podium Presentations. <i>Galleria North</i>. Chair: B. Holly Smith
2:00-2:15	Life history of wild western gorillas (<i>Gorilla gorilla</i>): new data and cross-site comparisons indicate gorillas do not grow and reproduce as fast as you think. D.M. DORAN-SHEEHY, P. MONGO, J.L. LODWICK, R. SALMI, C. BORRIES.
2:15-2:30	The impact of variation in the progesterone receptor gene, life history and lifestyle on endometrial function and the menstrual cycle . E. ROWE, J. JOSEPH, H. PATEL, S. JERONIS, T. EISENSTEIN, L. ROCKWELL.
2:30-2:45	Species differences in the ontogeny of testosterone production between chimpanzees and bonobos. V. WOBBER, S. LIPSON, B. HARE, R. WRANGHAM, P. ELLISON.
2:45-3:00	Dietary, behavioral, and hormonal comparisons of female red colobus monkeys (<i>Procolobus rufomitratus</i>) in logged and unlogged areas of Kibale National Park, Uganda . K. MILICH, R. STUMPF, C. CHAPMAN, J. BAHR.
3:00-3:15	Nursing and maternal energy balance in wild Sanje mangabeys, <i>Cercocebus sanjei</i>, in the Udzungwa Mountains, Tanzania. G.M. MCCABE, M. EMERY THOMPSON.
3:15-3:30	Long-term consequences of reduced maternal investment in rhesus macaque daughters. K. HINDE, M. WECHSLER.
3:30-3:45	Reproductive energetics in primates: how costly are babies?. P.C. LEE, L. ROSETTA, C. GARCIA.
3:45-4:00	Break
4:00-4:15	C-peptide and the cost of reproduction in Bornean orangutans . C.D. KNOTT, M. EMERY THOMPSON.
4:15-4:30	Why does time spent gestating and lactating scale differently with body size across primates?. D. JANIE, M. COLLARD, A.O. MOOERS.
4:30-4:45	Testosterone, development and aging in wild chimpanzees. M.N. MULLER, M. EMERY THOMPSON, Z. MACHANDA, R.W. WRANGHAM.
4:45-5:00	Developing the brain: A potential role for the placenta in hominin brain evolution. J.N. RUTHERFORD, E.T. ABRAMS, S.J. SAID.
5:00-5:15	Weaning and tooth emergence in a seasonal world: implications for primate evolution. B. SMITH.
5:15-5:30	Cooperative breeding, child health, and growth among the Aka foragers. C.L. MEEHAN.
5:30-5:45	Differences in urinary progesterone metabolites levels in two populations of peri-menopausal women in Argentina: Early developmental effects?. C.M. MCGUINNESS, P. PHOJANAKONG, C.R. VALEGGIA.
5:45-6:00	The relationship between strenuous physical activity and C-reactive protein is cycle-phase dependent: results from rural Poland. K.B. CLANCY, L.D. KLEIN.
Session 25	FINDING OUR INNER ANIMAL: UNDERSTANDING HUMAN EVOLUTIONARY VARIATION VIA EXPERIMENTAL MODEL SYSTEMS. Invited Podium Symposium. <i>Galleria South</i>. Chair: Nathan M. Young and Maureen J. Devlin
	Non-primate animal models have become an increasingly important component of research in physical anthropology. In particular, controlled animal studies enable testing and refinement of evolutionary hypotheses by providing experimental and comparative data that can then be correlated with observational studies in living human and non-human primates. This symposium showcases exciting new research by physical anthropologists at the forefront of this approach. Each speaker will discuss how animal model systems are important and relevant to anthropological inquiry by addressing one of two key questions: (1) how has diet impacted human evolutionary variation, and (2) what is the genetic and/or developmental basis for evolutionary variation in the human skull, limbs and teeth? The ultimate goal of this symposium is to help foster the continued integration of experimental comparative biology with physical anthropology.

 Friday April 13th, 2012 Afternoon Sessions

2:00-2:15	Are you what your mom ate? A model for developmental programming of human osteoporosis and obesity. M.J. DEVLIN, L. LOUIS, C. CONLON, M. VAN VLIET, M.L. BOUXSEIN.
2:15-2:30	Alternative energy: modeling the effects of processed diets on human energy metabolism. R.N. CARMODY, R.W. WRANGHAM.
2:30-2:45	Force of habit: dietary properties, masticatory function and cranial plasticity. M.J. RAVOSA, S.K. KHANNA, H. ZHU.
2:45-3:00	Chewing on something new: an experimental model for primate dietary variability. R.A. MENEGAZ, A.F. SZCZODROSKI, T.L. ROLD, T.J. HOFFMAN, M.J. RAVOSA.
3:00-3:15	Fire and Tools: combining animal and human experiments to study food processing and cranio-dental integration. K.D. ZINK, D.E. LIEBERMAN.
3:15-3:30	Rodents and monkeys and apes, Oh my: comparative and experimental investigations of systemic skeletal robusticity in rodents and primates. L.E. COPEL, E.M. DLUGOSZ, K.J. JEPSEN, S. JUDEX, S. LUBLINSKY, H. SCHUTZ, S.M. TOMMASINI, A. TRINWARD, T. GARLAND, JR..
3:30-3:45	Break
3:45-4:00	The middle-out approach and evolutionary inference from studies of model organisms. B. HALLGRIMSSON, N.M. YOUNG, H.A. JAMNICZKY, R.S. MARCUCIO.
4:00-4:15	Why the long face? Disease phenotypes as a window on evolutionary change. J.T. RICHTSMEIER, N. MARTÍNEZ-ABADÍAS, Y. HEUZÉ, C.J. PERCIVAL, S.M. MOTCH, Y. WANG, E.W. JABS, K. ALDRIDGE, T.M. RYAN.
4:15-4:30	Making faces: genes, development, and the evolution of human cranial shape. N.M. YOUNG, J.C. HUANG, J.S. LEE, B. HALLGRÍMSSON, R.S. MARCUCIO.
4:30-4:45	A study of character: developmental approaches to modularity, integration and evolvability of the craniofacial skeleton. J.L. FISH, B.A. VILLMOARE, C. DUNMORE, S. KILPATRICK, M.J. DEPEW, R.S. MARCUCIO.
4:45-5:00	Papa was a gnathostome (and Mama was dentate): modeling primate jaw and tooth evo-devo using a “toothless” mouse mutant. J.C. BOUGHNER, U. KAPOOR, M.T. RAJ.
5:00-5:15	When evolution hurts: height, arthritis risk, and the regulatory architecture of <i>GDF5</i> function. T.D. CAPELLINI, H. CHEN, D. KINGSLEY.
5:15-5:30	Using artificial selection in mice to understand the mechanisms of human skeletal evolution. C. ROLIAN.
5:30-5:45	Discussant, D. LIEBERMAN
Session 26	EARLY MAN IN SOUTH AMERICA: NEW PARADIGMS IN LATE PLEISTOCENE / EARLY HOLOCENE BIOLOGICAL ANTHROPOLOGY. Invited Podium Symposium. <i>Grand Ballroom II</i>. Chair: Mark Hubbe and Andre Strauss
	In 1912, Aleš Hrdlicka published his critical review of the existence of early man in South America based on his own expedition to Argentina. His main concern was an evaluation of the available evidence for an early human presence in the continent so that he could attempt to understand its implications for the general framework of human evolution that was under discussion at the time. Hrdlicka considered each aspect of the broader archaeological context including chronology, taphonomy, and geoarchaeology. On the centennial of this seminal work, this two-part symposium, presented at the SAA and AAPA, is intended as an homage that critically reviews the processes of modern human dispersion into South America and their relevance for the understanding of modern human history. The first part, presented here, focuses on the bioanthropological aspects of these topics. The partner to this session will be presented at the 77th SAA meeting, focusing on the archaeological perspective of human dispersion into the continent. In this session, we aim to discuss: 1) the biological origins of early South Americans from the perspective of South and North American anthropologists/geneticists; 2) intra-continental biological diversity and dispersion routes; 3) micro-evolution of humanity in South America since its initial settlement emphasizing biological adaptation and diversification; and 4) dispersion scenarios for human groups within the continent.
2:00-2:15	Cranial morphology of early human skeletal remains from Lapa do Santo, Lagoa Santa, Brazil: Implications for the settlement of the New World. D.V. BERNARDO, W.A. NEVES, A. STRAUSS, T.F. ALMEIDA, R.E. OLIVEIRA.
2:15-2:30	Scenarios for the early settlement of the Americas and the importance of recurrent gene flow with Asia. S. DE AZEVEDO, A. NOCERA, C. PASCHETTA, L. CASTILLO, M. GONZALEZ, R. GONZALEZ-JOSE.
2:30-2:45	Diachronic cranial morphological diversity in South America: a functional approach. M. HUBBE, A. STRAUSS.

Friday April 13th, 2012 Afternoon Sessions

2:45-3:00	Oral health and implications for diet in the Early Holocene Paleoindians of Lagoa Santa, Brazil. P.T. DA-GLORIA, C.S. LARSEN.
3:00-3:15	A major migration followed by recurrent gene flow as a model for the peopling of Americas: a patrilineal perspective . F.R. SANTOS, D.R. LACERDA, M.S. JOTA, J. SANDOVAL, S.L. BONATTO, R. GONZÁLES-JOSÉ, M. BORTOLINI, G. CONSORTIUM.
3:15-3:30	Understanding early human demography variation and Mt haplogroup distribution in the Americas. J. LANATA, C. DEJEAN, C. CRESPO, R. CARNESE.
3:30-3:45	Break
3:45-4:00	Genome-wide markers and the peopling of South America. C.M. LEWIS, M. JAKOBSSON, R.Y. TITO.
4:00-4:15	Incorporating gene flow in evolutionary models for the peopling of the Americas to estimate the size of the founder population. N.J. FAGUNDES, A. TAGLIANI-RIBEIRO, F.M. SALZANO, S.L. BONATTO.
4:15-4:30	The timing and process of the colonization of South America: a North American perspective. T.G. SCHURR, M.C. DULIK, M.G. VILAR, A.C. OWINGS, J.B. GAIESKI.
4:30-4:45	Ancient DNA perspectives on the peopling of South America. D.H. O'ROURKE, J.C. TACKNEY, G. FIGUEIRO.
4:45-5:00	Discussant, K. HARVATI
Session 27	HUMAN AND NONHUMAN POPULATION AND PHYLOGENETIC STUDIES. Contributed Podium Presentations. Parlors. Chair: Lisa M. Paciulli
2:00-2:15	Scat-detecting dogs as effective means to locate fecal samples from unhabituated primates. J.D. ORKIN, X. JIANG.
2:15-2:30	New population estimates of Pagai Island, Mentawai, West Sumatran primates. L.M. PACIULLI, S. BARGER.
2:30-2:45	Phylogenetic relationships, biogeography, and taxonomy of spider monkeys (<i>Ateles sp.</i>). A. MORALES-JIMENEZ, L. CORTES-ORTIZ, A. DI FIORE.
2:45-3:00	Biogeography of squirrel monkeys (<i>Saimiri</i>). J.W. LYNCH ALFARO, M.E. ALFARO.
3:00-3:15	Phylogenetic position of the yellow-tailed woolly monkey based on whole mitochondrial genomes. A. DI FIORE, F. CORNEJO, P.B. CHAVES, S. SHANEE, C.A. SCHMITT, L. CORTÉS-ORTIZ, C. ROOS, V. PACHECO.
3:15-3:30	Assessing the pattern of Neandertal ancestry in living human populations. J. HAWKS.
3:30-3:45	The soundness of the Cheverud Conjecture and its implications for the study of human evolution . C.C. ROSEMAN.
3:45-4:00	Break
4:00-4:15	Testing evolutionary mechanisms for patterns of craniofacial morphology: distinguishing between neutral forces and selective forces of evolution. N. SEGUCHI, R.W. SCHMIDT, A. MCKEOWN.
4:15-4:30	Recombination networks as genetic markers in a human variation study of the Old World. F. CALAFELL, M. MELÉ, A. JAVED, M. PYBUS, P. ZALLOUA, M. HABER, D. COMAS, M.G. NETEA, O. BALANOVSKY, O. BALANOVSKA, L. JIN, Y. YANG, G. ARUNKUMAR, R. PITCHAPPAN, J. BERTRANPETIT, L. PARIDA, T. CONSORTIUM.
4:30-4:45	The origin of Amerindians and the peopling of the Americas according to HLA genes: admixture with Asian and Pacific people. A. ANTONIO, C. ARECES, M. ENRIQUEZ DE SALAMANCA, M. FERNANDEZ-HONRADO, S. ABD-EL- FATAH-KHALIL, D. REY.
4:45-5:00	Ancient DNA evidence of population replacement following the Aztec conquest of Xaltocan, Mexico. J. MATA-MIGUEZ, D.A. BOLNICK, L. OVERHOLTZER, E. RODRIGUEZ-ALEGRIA.
5:00-5:15	Variability in genetic ancestry in New Mexican Hispanics: the product of a rich and ever-changing ethnic landscape. M.E. HEALY, J.M. GROSS, M. BERWICK, D. HILL, E. ERDEI, J.C. LONG, K.L. HUNLEY.
5:15-5:30	Genetic analysis of ancient <i>Mycobacterium tuberculosis</i> complex DNA from Precolumbian Late Woodland and Mississippian sites in the lower Illinois River Valley. G.G. MILLWARD, J. HARRISON, D.C. COOK, F.A. KAESTLE.
5:30-5:45	Sub-Saharan African and West Eurasian maternal (mtDNA) lineages in the Dominican Republic . M.A. NIEVES-COLON, H.J. DIAZ-ZABALA, J.C. MARTINEZ-CRUZADO.

 Friday April 13th, 2012 Afternoon Sessions

5:45-6:00 **The timescale and evolutionary dynamics of *Mycobacterium tuberculosis* infection in humans** . A. KITCHEN, C.S. PEPPERELL.

Session 28 **WORKING NINE TO FIVE: THE FUTURE OF ACTIVITY-RELATED STRESS. Invited Poster Symposium. *Forum Suite*.**

Chair: Charlotte Y. Henderson and Francisca Alves Cardoso

1:30-2:00 pm Poster set-up

5:00-5:30 pm Poster take-down

Enthesal changes (formerly called musculoskeletal stress markers or MSM) have been widely used to record activity-related stress. However, recent research is shedding new light on the subject: the simplistic one-dimensional link between activity and enthesal changes is being questioned. New methods are being applied to examine the relationship, including using identified skeletal remains with known occupations, 3-dimensional analysis of the entheses, as well as new visual recording methods. The aim of this symposium is to focus on re-evaluating enthesal changes; to reconsider their potential; to highlight limitations as well as future research directions and to promote discussion.

1 **The categorization of occupation in Identified Skeletal Collections: a source of bias?** . F. ALVES CARDOSO, C. HENDERSON.

2 **Occupational mobility in nineteenth century rural England: the interpretation of enthesal changes.** A.C. CAFFELL, C.Y. HENDERSON, A.R. MILLARD, R. GOWLAND.

3 **Enthesal changes: do they reflect socioeconomic status in the Early Medieval Great Moravian population? (Mikulčice, Czech Republic, 9th – 10th century)** . P. HAVELKOVÁ, M. HLADÍK, P. VELEMÍNSKÝ.

4 **The effect of age on enthesal changes at some fibrocartilaginous entheses.** C.Y. HENDERSON, V. MARIOTTI, D. PANY-KUCERA, G. PERRÉARD-LOPRENO, S. VILLOTTE, C. WIL ZAK.

5 **First insight into the relationship between upper-limb musculoskeletal markers, cross-sectional properties and diaphyseal contour shape.** P. IBÁÑEZ-GIMENO, X. JORDANA, S. DE ESTEBAN-TRIVIGNO, J. MANYOSA, A. MALGOSA, I. GALTÉS.

6 **The relationship between intensity of physical activity and musculoskeletal stress markers on the lower limb.** L. BAIGES SOTOS, S.T. NIINIMÄKI.

7 **Effects of age-at-death, sex, body size and secular change on the biceps enthesis; a study of 3D surface areas** . M.L. NOLTE, C. WILCZAK.

8 **Working activities or workload? categorization of occupation in identified skeletal series for the analysis of activity-related osseous changes.** G. PERRÉARD LOPRENO, F. ALVES CARDOSO, S. ASSIS, M. MILELLA, N. SPEITH.

9 **Comparison of the enthesal changes in the hip bone of Portuguese males (19th-20th centuries) with known occupational.** A.L. SANTOS, V. CAMPANACHO.

10 **Medial versus lateral epicondyle enthesopathies through time: Implications for behavioural reconstruction.** S. VILLOTTE, C.J. KNÜSEL.

11 **Discussant, C KNUSEL**

Saturday. All Day Sessions.

Session 29 **HUMAN AND PRIMATE BIOLOGY: GROWTH, DEVELOPMENT, NUTRITION, DEMOGRAPHY, EPIDEMIOLOGY, AND REPRODUCTION. Contributed Posters. *Plaza Level*.**

Chair: Stacey R. Tecot

7:30-8:00 am Poster set-up

4:00-4:30 pm Poster take-down

10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion

10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion

Saturday April 14th, 2012 All Day Poster Sessions

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|----|---|
| 1 | Growing old in Ranomafana National Park: locomotor proficiency in young and old <i>Propithecus edwardsi</i>. E.J. ACHILLES, L.R. GODFREY, S.J. KING, P.C. WRIGHT. |
| 2 | Developmental instability and fluctuating asymmetry in the infant brain. E.N. SMALLMON, J.R. AUSTIN, R.J. DESAI, L.G. HOWELL, K.K. COLE, I.D. GEORGE, J.L. MARSH, A.A. KANE, J. PANCHAL, J.T. RICHTSMEIER, K. ALDRIDGE. |
| 3 | Maternal mortality and morbidity in Miskito adolescents: biological and social vulnerability. S. ARPS. |
| 4 | Stable isotopes and socioeconomic differences among urban Colombian women: additional insights from ³⁴S. R.L. BENDER, D.L. DUFOUR, L.O. VALENZUELA, T.E. CERLING, M. SPONHEIMER, J.C. REINA, J.R. EHLERINGER. |
| 5 | Patterns of dental eruption and growth in a wild population of Guinea baboons (<i>Papio h. papio</i>) in the Department of Kedougou, Senegal. B.R. BENEFIT, E. SIMONS, O.M. DIOP, M. DIALLO, A.A. SALL, K.A. HANLEY, S.C. WEAVER, D.D. CUMMINGS. |
| 6 | Diet predicts milk composition in primates. G.E. BLOMQUIST, K.J. HINDE, L.A. MILLIGAN. |
| 7 | The influence of grandmothers on sustained breastfeeding. K. BOISVERT MEYER, A. GASKINS, M. PATINO, M.E. GLENN, M. RAMSIER. |
| 8 | Seasonality of infectious disease in Åland, Finland. J.T. BOYD, J.H. MIELKE. |
| 9 | Japanese-Americans show increased frequency of diary reports of negative moods compared to other ethnic groups during the peri-menopause: the Hilo Women's Health Study. D.E. BROWN, L.L. SIEVERT, L.A. MORRISON. |
| 10 | Measuring the contribution of genetic and non-genetic factors to variation in stress physiology in a captive population of male baboons (<i>Papio</i> sp.). J. CALIFF, J. ROGERS, L. GESQUIERE, C.J. JOLLY. |
| 11 | Estimation of cranial capacity from linear measurements in juvenile orangutans. J.A. CREEL, J.G. SURLS, A.C. DURBAND. |
| 12 | Human ecology of Lyme disease: establishing variability in exposure potential to tick populations. J.M. DARCY II, G. DEVEVY, E. ARNOLD, J. MACKAY, R.M. GARRUTO, D. BRISSON. |
| 13 | Gross characteristics and microscopic architecture of the vervet monkey (<i>Chlorocebus sabaeus</i>) placenta: Implications for anthropoid primate brain growth. V. DEMARTELLY, P. HURLEY, M. LAWRENCE, D. REDMOND, J. RUTHERFORD. |
| 14 | Hard tissue research on Sub-Saharan Africans of known life history. T.G. BROMAGE, Y.M. JUWAYEYI, J.C. DIMAGGIO, B. HU, J. CHISI. |
| 15 | Captive female orangutans do not exhibit hormonal signs of age-related reproductive decline . L.S. DURGAVICH. |
| 16 | The trouble with tarsiers: heterogeneity in the relationship between neocortex volume and social group size in primates. M.G. ELLIOT. |
| 17 | Is age at menarche related to final stature within individuals considered longitudinally?. B.A. FLOYD. |
| 18 | Investigation into human sacral fusion with regard to skeletal age. C.L. FOJAS, N.R. SHIRLEY, N.V. PASSALACQUA. |
| 19 | In poor families mothers' milk is richer for daughters than sons: an example of Trivers-Willard effects on mother's milk in northern Kenya . M. FUJITA, E.A. ROTH, Y. LO. |
| 20 | Patterns of morphological integration in the brain in infants with craniosynostosis. R.J. DESAI, J.R. AUSTIN, E.N. SMALLMON, L.G. HOWELL, K.K. COLE, I.D. GEORGE, J.L. MARSH, A.A. KANE, J. PANCHAL, J.T. RICHTSMEIER, K. ALDRIDGE. |
| 21 | Evolutionary life history and the impact of a development intervention project on out-migration in rural Ethiopia. M.A. GIBSON, E. GURMU. |
| 22 | Nutritional stress and the pattern of fluctuating asymmetry in the skull. P.N. GONZALEZ, E.E. OYHENART, B. HALLGRIMSSON. |
| 23 | Constraints on sexually selected traits in a high-altitude tarsier species, <i>Tarsius pumilus</i>. N.B. GROW. |
| 24 | Differential mortality in Albany using cemetery and skeletal data. S.E. HEINS. |
| 25 | Allomaternal nursing among hunter-gatherers. B. HEWLETT, S. WINN. |
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 Saturday April 14th, 2012 All Day Poster Sessions

- 26 **Congruence of brain and skull in endocast reconstruction of the infant brain.** L.G. HOWELL, J.R. AUSTIN, R.J. DESAI, K.K. COLE, E.N. SMALLMON, C.A. HILL, I.D. GEORGE, J.T. RICHTSMEIER, J.L. MARSH, A.A. KANE, J. PANCHAL, K. ALDRIDGE.
- 27 **COMP gene related malformations of the skull: evidence from Egyptian V-VIth dynasty skeletal remains.** C.L. IBARRA, G.D. RICHARDS, C.F. HORTON, H.M. OJEDA, H. ASADI.
- 28 **Red is not a proxy signal for human female genitalia.** S.E. JOHNS, L.A. HARGRAVE, N.E. NEWTON-FISHER.
- 29 **Understanding historical and contemporary tuberculosis: the ties between TB and helminths in the Pacific.** J.H. LITTLETON, J.K. PARK, T. NELESONE.
- 30 **Mortality of a Swiss urban population in the early 19th century.** D. RUETTIMANN, S. LOESCH.
- 31 **The Shuar Health and Life History Project: lifestyle and dietary correlates of skeletal health among the indigenous Shuar and non-Shuar *Colonos* of Ecuadorian Amazonia .** F.C. MADIMENOS, J.J. SNODGRASS, M.A. LIEBERT, T.J. CEPON, L.S. SUGIYAMA.
- 32 **"Influence of aquatic resources and subsistence strategy on human milk fatty acid composition: a cross-cultural analysis".** M.A. MARTIN, W.D. LASSEK, S.J. GAULIN, R.W. EVANS, H.S. KAPLAN, J.G. WOO, A.L. MORROW, M.D. GURVEN.
- 33 **Birth size, early weight gain, and diet: relationships to weight-for-length during the first year.** R.L. MAY, D. KIM.
- 34 **Reproductive decision-making in the Bolivian Amazon: why do fertility preferences not match outcomes?.** L.S. MCALLISTER, M. GURVEN.
- 35 **A new method for measuring surface area of the infant anterior fontanelle utilizing CT data.** E.A. MOFFETT, K. ALDRIDGE.
- 36 **Arboviruses in Historic Natchez: Genetic and Socio-Cultural Factors in Mortality Disparities.** N. MUSSELWHITE.
- 37 **Birth seasonality in relation to rainfall and food in wild geladas (*Theropithecus gelada*) at Guassa, Ethiopia: Variation within and between one-male units.** N. NGUYEN, P.J. FASHING.
- 38 **Socioeconomic status and duration of breastfeeding explain childhood adiposity in boys but not girls.** D.L. OSBORNE, S. ELLIOTT, J. WAGONER.
- 39 **Transitions in mortality and documented causes of death: North Orkney (1855-1955).** D.M. PARKER, J.A. JENNINGS, J.W. WOOD.
- 40 **The influence of grandmothers on postpartum health of mother and infant.** M. PATIÑO, A. GASKINS, K. BOISVERT MEYER, A. REMER, M. RAMSIER, M.E. GLENN.
- 41 **Genetic factors influence serological measures of common, chronic infections in Alaskan Eskimo participants in the GOCADAN study.** R. RUBICZ, J. ZHU, S. LASTON, S.A. COLE, S.O. EBBESSON, B.V. HOWARD, J.W. MACCLUER, M. DAVIDSON, J. UMAN, A.G. COMUZZIE, H.H. GORING.
- 42 **Energy expenditure in semi free-ranging chimpanzees measured using doubly labeled water.** K.K. SCHROEPFER, B. HARE, H. PONTZER.
- 43 **Acculturation, chronic psychosocial stress, and health among Latino mother-child pairs in Texas.** J.J. SNODGRASS, M.F. WIESNER, C.R. MARTINEZ, C.D. KAPLAN, D.M. CAPALDI.
- 44 **Developmental instability in the Down syndrome face.** J.M. STARBUCK, R.H. REEVES, T.M. COLE III, J.T. RICHTSMEIER.
- 45 **The evolution of allomaternal care in lemuriforms.** S.R. TECOT, A.L. BADEN, N.K. ROMINE, J.M. KAMILAR.
- 46 **Developmental changes in the spatial organization of neurons in the neocortex of humans and chimpanzees.** K. TEFFER, D. BUXHOEVEDEN, C.D. STIMPSON, A.J. FOBBS, C.C. SHERWOOD, K. SEMENDEFERI.
- 47 **Secular change in stature among Nigerian populations.** M.L. TISE, M.A. POPE, E.H. KIMMERLE.
- 48 **Environmental influences on the activity patterns of a captive group of spider monkeys (*Ateles fusciceps rufiventris*).** E.M. VANREGENMORTER.
- 49 **Farming, food and fitness in highland Ethiopia: anthropometric and dental indicators .** M.S. WILLIS, S.G. BEYENE, R. HAMES, B. LEGESSE, M. MAMO, T. REGASSA, T. TADESSE, Y. WOLDE-HAWARIAT.
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 Saturday April 14th, 2012 All Day Poster Sessions

50	Subadult age estimation at Tell-el Amarna: a systematic, site-specific approach . G.R. DABBS, M. ZABECKI.
Session 30	HUMAN ADAPTATION AND HUMAN VARIATION. Contributed Posters. Plaza Level. Chair: Karen L. Baab
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
51	A structured approach to human population variation: the application of model-based clustering to world-wide craniometric data. B.F. ALGEE-HEWITT.
52	Using pathology to explore cranial integration in <i>Homo sapiens</i>. K.L. BAAB.
53	Limbic structures in human evolution: new data and a meta-analysis. N.L. BARGER, K.L. HANSON, K. SEMENDEFERI.
54	Warm-climate foragers have less famine than other societies. J.C. BERBESQUE, F.W. MARLOWE.
55	Detecting modular components on human skull: implications to the structuring of global human cranial variation. D.V. BERNARDO, T.F. ALMEIDA, D.V. BERNARDO.
56	Categorising evolution: moving beyond the binary. K. BRYSON.
57	A reassessment of the applicability of Bergmann's Rule to humans. M. COLLARD, F. FOSTER.
58	Twa (pygmies) and the comparative energetics of gathering and farming: the energetic significance of the transition to agriculture. A.J. CUNNINGHAM, V.V. VENKATARAMAN, N.J. DOMINY.
59	Measuring up: the analysis of postcranial traits for the assessment of biological distance among temporally distinct New World populations of African descent . C.M. DANSEREAU.
60	Implications of functional single nucleotide polymorphisms in Manitoba First Nation health . K. DECTER, L. LARCOMBE, S. MATYAS, B. MARTIN, P. NICKERSON, P. ORR.
61	Unassisted child birth in the US: results from an online survey. N.L. FALK-SMITH.
62	Of supper and salvors: excavations at Audubon house (site 8MO220) Key West, FL. M. FARALDO, L.L. TAYLOR.
63	Sexual dimorphism: a comparison of migrant and non-migrant Mexican populations. C. FIGUEROA-SOTO, K.M. SPRADLEY.
64	The effects of living conditions on human cranial and postcranial sexual dimorphism. H.M. GARVIN.
65	Variation in bone mineral density of the proximal femur: It is not just about age and sex. R.A. GONZALEZ.
66	Cooperative breeding and hominin brain size evolution: evidence from a comparative study in birds . S. GRABER, C.P. VAN SCHAIK, K. ISLER.
67	Therapeutic outcomes of medicinal plant applications in three cultural groups. R.A. HALBERSTEIN.
68	Sexual dimorphism of the bony labyrinth in modern humans: a pilot study. B. OSIPOV, E. KRANIOTI, K. HARVATI.
69	A comparison of craniometric and molecular data from North and Central Mexico. B.C. HERRERA, M.K. SPRADLEY.
70	Do Kenyan grandparents invest in their grandchildren according to evolutionary predictions?. G.H. ICE.
71	The reproducibility of increased blood pressure variability during sleep in women. G.D. JAMES.
72	Minimum cost of transport and optimal velocity: what variables are predictive?. P.A. KRAMER.

 Saturday April 14th, 2012 All Day Poster Sessions

73	A quantitative assessment of body perception: Elliptic Fourier Descriptors. P.E. LESTREL, N. MIYAKE, M. ISHIHARA, A. BODT.
74	Associations between localized variation in brain anatomy and social behavior in healthy human subjects . M.M. LOYET, P. SCHOENEMANN, B.B. AVANTS, J.C. GEE.
75	Reputation dynamics in a Dominican village: altruism, economic competency, and social affiliation. S.J. MACFARLAN.
76	Does “The Extrinsic Risk Hypothesis” explain cross-cultural variation in age at introduction of transitional foods?. L. MCKERRACHER, D. SELLEN, P. NEPOMNASCHY, M. COLLARD.
77	Trade-offs in relative limb length among Andean children: evidence for extending the thrifty phenotype hypothesis to limb growth. E. POMEROY, J.T. STOCK, S. STANOJEVIC, J. MIRANDA, T.J. COLE, J.C. WELLS.
78	Energetics, power laws, and Paleolithic mobility. L.S. PREMO.
79	Species-specific distributions of cholinergic innervation in the neocortex of anthropoid primates. M. RAGHANTI, T. BOHUSH, J. SUDDUTH, J.M. ERWIN, P.R. HOF, C.C. SHERWOOD.
80	Aerobic activity in the Hadza hunter-foragers of Tanzania. D.A. RAICHLEN, H. PONTZER, B.M. WOOD, A.Z. MABULLA, F.W. MARLOWE.
81	Presentation Withdrawn
82	Bitrochanteric breadth and calf circumference: predictors of energy expenditure. E.R. REINHOLZ, P.A. KRAMER.
83	Shape analysis of the palpebral fissure in humans. A. RÜDELL.
84	Sliding semi-landmarks on symmetric structures in three dimensions. S. SCHLAGER.
85	Form variation in the human knee joint: a geometric morphometric analysis of variation in the distal femur and proximal tibia in thirteen distinct populations. S.D. STEVENS, U. STRAND VIDARSDOTTIR.
86	The gluten “addiction”: for the love of bread and pasta. J.C. STEVENSON, C.L. MAKI, P. SAFFAIE, K. RANKIN-SUNTER, M. MOSHER.
87	Comparison between Von Luschan tiles and spectrophotometry in human skin color variation. A.K. SWIATONIEWSKI, E.E. QUILLEN, M.D. SHRIVER, N.G. JABLONSKI.
88	The role of glia in human brain evolution . N.D. TAYLOR, T.M. PREUSS.
89	I am hot! No, you’re not: an investigation of the complex relationship between self-perception of mate value and the assignation of mate value by others. N.H. THOMPSON, M. MEJIA, B.E. HEMPHILL.
90	An analysis of global human mandibular variation in the context of agricultural versus hunter-gatherer subsistence strategies. N. VON CRAMON-TAUBADEL.
Session 31	SKELETAL BIOLOGY: PALEOPATHOLOGY, WARFARE, POPULATION HISTORY. Contributed Posters. Plaza Level. Chair: Jo Buckberry
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
91	Investigation of intra-site cranial morphological variation at Sully (39SL4) using geometric morphometry. E.R. AGOSTO, A. MCKEOWN.
92	Cranio-metric variation of a comprehensive sample of early Americans: comparisons and initial observations. K.T. ALSUP.

 Saturday April 14th, 2012 All Day Poster Sessions

- 93 **Epidemiology of developmental dysplasia of the hip in Amerindians: Cases from the Late Prehistoric Buffalo Site, West Virginia.** S.H. BLATT.
- 94 **'From Cemetery to Clinic': 3D Digitised pathological data from archaeological leprous skeletons.** J. BUCKBERRY, A. HOLLAND, C. GAFFNEY, R. HOLGATE, K. MANCHESTER, A. OGDEN, T. SPARROW, R. STORM, H. UGAIL, C. WATKINS, A. WILSON.
- 95 **Working our fingers to the bone: osteoarthritis in the hands of a historic population.** C.L. CHAMBERS, D. CASE.
- 96 **Blunt or sharp force trauma: differential diagnosis of a lesion on a Bronze Age skull from Uglemose, Denmark.** L. COLLIER, C. VILLA.
- 97 **Bad luck, or bad intentions? Interpreting fractures from an early 20th century pauper cemetery.** S.P. DOUGHERTY.
- 98 **Significance of the UI-Stanford Collection.** D.M. EDDIE, J.S. VANG, S.M. JOHNSON, S.J. SCHERMER.
- 99 **Diseases of early first Millennium B.C. mounted Pastoralists in the Kunlun Mountains, China.** J. GRESKY, T.H. SCHMIDT-SCHULTZ, M. SCHULTZ.
- 100 **Surviving tuberculosis: healing of skeletal lesions during the recovery from active disease.** K.L. HOLLOWAY, K. LINK, F.J. RÜHLI, M. HENNEBERG.
- 101 **Cranial variation among modern Maya: assessing the effects of Spanish colonialism.** C.E. HUGHES.
- 102 **Social evolution in the Upper Mun River Valley, Thailand: using isotopic, non-metric and geometric morphometric evidence to elucidate past social structures.** C.L. KING, U. STRAND-VIDARSDÓTTIR, R. BENTLEY.
- 103 **Stigmata of congenital syphilis on two high status pre-Colombian juveniles from Oaxaca, Mexico .** A.T. MAYES, S.B. BARBER, A.A. JOYCE.
- 104 **Activity or age? Determining the etiology of enthesopathies in the Newburgh Colored Burial Ground.** J.L. MULLER.
- 105 **Frequencies of periostitis and enamel hypoplasias in a Colonial Maya population.** M.C. MURPHY, R.R. PAINE.
- 106 **Moche amputation: punishment or pathology?.** J.N. RIVERA, T. SETZER.
- 107 **Osteoarthritis of the hands: analyses of bones from the Coimbra identified collection (19th-20th centuries).** C. MARQUES, M. CARAPINHA, A. SANTOS.
- 108 **Bony responses associated with a malaria infection.** T.J. SETZER.
- 109 **Batle of the sexes: Identifying victims of domestic abuse in the archaeological record.** C.A. SLOTTEN.
- 110 **Bone microstructural features combined with synchrotron radiation x-ray fluorescence spatial maps of lead and strontium in historical bone samples from Antigua suggests biogenic uptake.** T.M. SWANSTON, T. VARNEY, I. COULTHARD, C. HENNIG, R. MURPHY, D.M. COOPER.
- 111 **Human skeletal remains from Neale's Landing (46WD39), Blennerhassett Island, West Virginia.** K.J. WEINSTEIN, K. WALTERS, L. DONOHUE, A. SAID.
- 112 **Spatial variation in the cranial morphology of the Portuguese.** K.E. WEISENSEE.
- 113 **Degenerative joint disease and osteoarthritis in an Etruscan skeletal sample dating from the VIII century to the I century BC.** E.S. WILLIAMS, R.R. PAINE, M. CATALDI, F. TRUCCO, R. VARGIU, A.C. DURBAND.
- 114 **An analysis of the relationship between degenerative joint disease and enthesopathies in Korea's Joseon dynasty population.** E. WOO, S. PAK.
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 Saturday April 14th, 2012 All Day Poster Sessions

Session 32	PALEOANTHROPOLOGY. Contributed Posters. Plaza Level. Chair: Russell L. Ciochon
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
115	Amud 7, a Neandertal infant from Amud Cave, Israel. E. BEEN, Y. RAK.
116	The positioning of the lunate sulcus in <i>Pan troglodytes</i>: a statistical analysis. M.A. BOAS, D. BROADFIELD, M. HARRIS.
117	Estimating turnover in fossil hominins from the Omo-Turkana Basin, Ethiopia and Kenya. R. BOBE.
118	Paranasal sinus shape in Pleistocene hominins. L.T. BUCK, C.B. STRINGER, A.M. MACLARNON, T.C. RAE.
119	Scaling and developmental integration in the <i>Paranthropus</i> head. B.A. BURDELSKY, R.C. MCCARTHY.
120	Clovis tools or Clovis people? a new approach using time-series conversion and dynamic time warping. J.W. CADE, S. LEE, E. KEOGH, T. RAMPLEY.
121	A phenetic analysis of the cranium of <i>Australopithecus sediba</i>. K.B. CARLSON, D.J. DE RUITER, T.J. DEWITT, L.R. BERGER.
122	Who left Africa first? A multivariate analysis of the Dmanisi crania. B.M. CHRISTY.
123	Climatic-volcanic framework for early hominin endemism on Sunda. R.L. CIOCHON, R. LARICK.
124	Mandibular growth in <i>Australopithecus robustus</i>: a computational approach. Z.D. COFRAN.
125	Functional morphology of the fossil hominin tarsus: new findings using 3D laser surface scans. A.D. COLLADO, W.E. HARCOURT-SMITH.
126	<i>Australopithecus afarensis</i> mandible with supernumerary molars from the Hadar site, Ethiopia. J.L. CONAWAY, W.H. KIMBEL.
127	Tracking ancient animal movements in northern Tanzania using strontium isotopes. S.R. COPELAND, D.N. REED, R.J. BLUMENSCHINE, J.K. NJAU, M. SPONHEIMER, M.P. RICHARDS.
128	A reanalysis of thermoregulation in <i>Homo erectus</i> and Neanderthals. A. CROSS, M. COLLARD.
129	Evaluating the impact of inter-taxon sample size variation on fossil hominin phylogenetics. M. DEMBO, M. COLLARD.
130	Estimating body mass in the <i>Theropithecus oswaldi</i> lineage using long bone ends. A.R. ELLER, S.R. FROST, E.H. GUTHRIE.
131	Enamel thickness and dental tissue proportions in Neanderthal and modern human upper deciduous molars. C. FORNAL, S. BENAZZI, P. BAYLE, I. PAP, J. SVOBODA, K. HARVATI, G.W. WEBER.
132	Ontogenetic development of postcranial adaptations to bipedalism in the rat. A.D. FOSTER.
133	Energy demands of growth in Neanderthal children. I. GOIKOETXEA, W.R. LEONARD, A. MATEOS, J.A. MARTÍN-GONZÁLEZ, G. RODRÍGUEZ-GÓMEZ, J. RODRÍGUEZ.
134	Precision and accuracy of acetabular size measures in fragmentary Plio-Pleistocene hominin pelves obtained using digital sphere-fitting techniques. A.S. HAMMOND, J. PLAVCAN, C.V. WARD.
135	Mechanical loading of the femoral neck in early hominins. R.W. HIGGINS, C.B. RUFF.
136	Postcranial morphology and the genus <i>Homo</i> hypodigm. T.W. HOLLIDAY.

 Saturday April 14th, 2012 All Day Poster Sessions

- 137 **Craneometric morphological patterns in hominin evolution.** J. JIMÉNEZ-ARENAS, J. PÉREZ-CLAROS, P. PALMQVIST.
- 138 **Occlusal microwear texture analysis of Croatian Neandertals.** W.M. KARRIGER, C.W. SCHMIDT, F.H. SMITH.
- 139 **Trabecular architecture of fossil hominin first metacarpals.** T.L. KIVELL, M.M. SKINNER, R.L. LAZENBY, J. HUBLIN.
- 140 **Anterior dental microwear textures of European Upper Paleolithic humans differed from those of Neandertals.** K.L. KRUEGER.
- 141 **Using mammalian microfauna to reconstruct Hominin paleohabitats in South Africa.** J.N. LEICHLITER, O.C. PAINE, M. SPONHEIMER, P. SANDBURG, D. DE RUITER, D. CODRON, N. AVENANT, T. MATTHEWS.
- 142 **A quantitative assessment of zygomaticoalveolar crest curvature in recent and fossil *Homo*.** S.D. MADDUX.
- 143 **An analysis of the Klasies River hominins using a hybrid model.** L. MALEKFAR.
- 144 **Evolutionary change in the hominin orbit: an analysis of orbital morphology in relation to neurocranial expansion and reduced facial prognathism since the middle Pliocene.** M.P. MASTERS.
- 145 **The functional morphology of the scapula.** S. MATHEWS.
- 146 **Encephalization in Pleistocene *Homo* revisited.** R.C. MCCARTHY, R.R. GRAVES, A.C. LUPO, D.L. CUNNINGHAM, D.J. WESCOTT.
- 147 **Functional anatomy of the thoracic vertebrae in early *Homo*.** M.R. MEYER.
- 148 **The functional morphology of the Hominoid fibula.** S. MEYER.
- 149 **Testing uniqueness of Inuit cranial shape and its effect on climate-shape analysis.** M.L. NOBACK, K. HARVATI, F. SPOOR.
- 150 **Mojokerto revisited: assessing brain growth patterns in *Homo erectus*.** C.A. O'CONNELL, J.M. DESILVA.
- 151 **The emergence of the band in human social and cognitive evolution.** S. O'HARA, R. LAYTON, A. BILSBOROUGH.
- 152 **Investigating hominin paleohabitats using fossil rodent ecomorphology.** O. PAINE, J. LEICHLITER, M. SPONHEIMER, N. AVENANT.
- 153 **Human fossils from the Paleolithic of Buticha Cave, Ethiopia: results from excavations in 2008 and 2011 with a consideration of the taphonomical context.** O.M. PEARSON, Z. ASSEFA, D. PLEURDEAU, E. HOVERS, A. ASRAT, Y.M. LAM, J. BAHAIN, A. LEPLONGEON, F. DUQUESNOY, J. LE QUELLEC, C. T/TSION.
- 154 **Estimating femoral head size in fragmentary fossils using 3-D surface scans.** J. PLAVCAN, D. PROVAZNIK, R. SPRING.
- 155 **Shape analysis of the proximal MT 4 and MT 5 articular surfaces.** D.J. PROCTOR.
- 156 **Integrating ecological proxies to understand the distribution of woody plants in African environments.** A.L. RECTOR, K.E. REED, C.J. CAMPISANO.
- 157 **Acetabulocrystal buttressing in hominins.** N.D. REED, S.E. CHURCHILL.
- 158 **Shape exploration of the third metacarpal capitate facet: implications for early hominin morphology.** T.R. REIN, K. HARVATI.
- 159 **An experimental analysis of butchery efficiency for Oldowan flakes based on flake size.** J.S. RETI, C.P. CARVAJAL.
- 160 **Geometric morphometric analysis of shape variation in the mandible of fossil and extant hominoids.** C.A. ROBINSON, K.P. MCNULTY, M.K. PITTIRI.
- 161 **Using GIS for paleoecological reconstructions: a case study from Laetoli, Tanzania.** M.E. SCHAEFFER, J. MENDELSON, D.F. SU.

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162	Dental microwear texture analysis of fossil bovids from Hadar, Ethiopia: implications for the paleoenvironment of <i>Australopithecus afarensis</i>. J.R. SCOTT.
163	Ecomorphology and phylogeny among the Bovidae: implications for habitat reconstruction. R.S. SCOTT, W. BARR.
164	A method to estimate the timing of linear enamel hypoplasia for Neandertals. A.E. STINESPRING HARRIS, D. GUATELLI-STEINBERG, D.J. REID, C. LARSEN, D. HUTCHINSON, T.M. SMITH.
165	3D biomechanical simulation of a fossilization process of a bony structure - New perspectives for the retrodeformation of paleo-anthropological fossils . G. SUBSOL, P. DALOUS, F. DURANTHON, B. MORENO, S. COTIN, J. BRAGA, J. JESSEL.
166	Comparisons of strength and predictability of Neanderthal and modern human femora using finite element analysis. K.H. TAMVADA, D.S. STRAIT.
167	Multivariate calibration and body mass estimation in fossil hominins. N.M. UHL, L.W. KONIGSBERG, C.W. RAINWATER.
168	New Neanderthal remains from Chagyrskaya Cave (Altai Mountains, Russian Federation). B.T. VIOLA, S.V. MARKIN, A.P. BUZHILOVA, M.B. MEDNIKOVA, M.V. DOBROVOLSKAYA, A. LE CABEC, M.V. SHUNKOV, A.P. DEREVIANKO, J. HUBLIN.
169	3D geometric morphometrics of the LBI mandible support the new species diagnosis (<i>Homo floresiensis</i>). K.A. VITERBO, W. JUNGERS, T. SUTIKNA, E. SAPTOMO, M. MORWOOD.
170	Darwin on Campus: An assessment of students' knowledge of Darwin and evolution on the 200th anniversary of his birth. M.L. WHITMAN, E.R. KUNZ, F.P. CUOZZO.
171	Resampling analysis of craniofacial sexual dimorphism in <i>Australopithecus africanus</i> and <i>A. robustus</i>. F.L. WILLIAMS, B.L. BENSHOOF.
172	Decreased maintenance energy expenditure in modern humans and the resultant demographic displacement of archaic humans . T.R. YOKLEY, A.W. FROEHLE, S.E. CHURCHILL.
Session 33	EVOLUTION OF PRIMATES. Contributed Posters. Plaza Level. Chair: Russell T. Hogg
	7:30-8:00 am Poster set-up 4:00-4:30 pm Poster take-down
	10:00-10:30 am and 2:00-2:30 pm Authors of even numbered posters present for discussion 10:30-11:00 am and 2:30-3:00 pm Authors of odd numbered posters present for discussion
173	New dental hominoid remains from the Late Miocene locality of Can Llobateres 1 (Vallès-Penedès Basin, Catalonia, Spain). D.M. ALBA, I. CASANOVAS-VILAR, S. ALMÉCIA, J.M. ROBLES, J. ARIAS-MARTORELL, S. MOYÀ-SOLÀ.
174	Sizing up Madagascar: trends in body mass evolution for five clades of Malagasy mammals. K.L. ALLDREDGE, L.R. GODFREY.
175	New earliest Eocene tarsal specimens of <i>Cantius</i> (Primates, Notharctinae) from central Wyoming. D.M. BOYER, J.T. GLADMAN, E.R. SEIFFERT, J.I. BLOCH, A. PERSAUD, J. PULINAT.
176	Systematics of Paleocene-Eocene micromomyid plesiadapiforms. S.G. CHESTER, J.I. BLOCH.
177	Dental morphology and dietary adaptation in <i>Homunculus patagonicus</i>. S.B. COOKE, R.F. KAY.
178	Variation in rates of tooth wear in a single primate population: effects of sex and microhabitat. F.P. CUOZZO, M.L. SAUTHER, P.S. UNGAR.
179	Paleodietary implications of the Pliopithecidae from dental microwear and relative enamel thickness of two Iberian taxa. D. DEMIGUEL, D.M. ALBA, J. FORTUNY.

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- 180 **Lines of least evolutionary resistance and the evolution of the canine honing complex.** L.K. DELEZENE.
- 181 **Study on the lateral distribution in the expression of brain-specific proteins in the cerebral cortex in the common chimpanzee (*Pan troglodytes*).** T. DUKA, M.A. SPOCTER, W.D. HOPKINS, S. ANDERSON, Z. COLLINS, C.D. STIMPSON, P.R. HOF, C.C. SHERWOOD.
- 182 **Biogeochemical assessment of forest structure and dietary ecology at Rudabánya .** L.C. EASTHAM, D.R. BEGUN, L. KORDOS.
- 183 **Inferring positional behavior on the basis of osteometric characters: a model for the fossil taxon *Epiplioptithecus vindobonensis*.** I.W. FELDER.
- 184 **Size and external morphology of the brains of the large fossil platyrrhines *Protopithecus* and *Caipora*.** A. KRUPP, C. CARTELLE, J.G. FLEAGLE.
- 185 **Unmasking the cryptic *Cercocebus/Mandrillus* clade in the fossil record: a new genus of Plio-Pleistocene African papionin from Ethiopia and Angola.** C.C. GILBERT.
- 186 **Detailed measurements of primate calcanei from 3D models allow for reliable body mass estimation.** J.T. GLADMAN, D.M. BOYER.
- 187 **Reconstructing Madagascar's vertebrate colonization history: a journey through time.** L.R. GODFREY, K.E. SAMONDS, J.R. ALL, S.M. GOODMAN, M. VENCES, M.R. SUTHERLAND, M.T. IRWIN, D.W. KRAUSE.
- 188 **An assessment of Bayesian methods for ancestral state estimation.** A.D. GOSSELIN-ILDARI, D.M. BOYER, M.E. STEIPER, E.M. ST. CLAIR.
- 189 **Locomotor morphology of *Theropithecus brumpti* .** E.H. GUTHRIE.
- 190 ***Paralouatta*, the Cuban enigma: evidence from craniodental morphology.** L.B. HALENAR, S.B. COOKE, M. TALLMAN, S. ALMECIJA.
- 191 **Dental macro- and micromorphology of a new pitheciid primate from the Miocene of Patagonia.** M.F. TEJEDOR, N.M. NOVO, R.T. HOGG, A.L. ROSENBERGER.
- 192 **Isotopic evidence of hominoid paleoenvironments and diets from Napak and Moroto, Uganda.** J. KINGSTON, L. MACLATCHY.
- 193 **Petrosal anatomy of *Afradapis longicristatus* (Primates, Adapiformes).** E. KIRK, E.R. SEIFFERT, E.L. SIMONS.
- 194 **A morphometric analysis of cranial ontogeny in the Hominoidea: implications for the growth and development of fossil primates.** S.A. KOZAKOWSKI, P. GUNZ, D.R. BEGUN.
- 195 **Phylogenetic analysis of facial orientation in modern *Homo sapiens* and *Pan troglodytes*.** E.R. LESLIE.
- 196 **Morphological diversity in the catarrhine pelvis: a comparative 3D geometric morphometric analysis.** S.J. LYCETT, N. VON CRAMON-TAUBADEL.
- 197 **The relationship between distal humeral morphology and tail length within the genus *Macaca*.** A.E. MACKENZIE, D.R. BEGUN.
- 198 **Size and shape in the primate forelimb.** M.E. MACIAS, C.E. WALL, S.E. CHURCHILL.
- 199 **The relationship between cortical bone thickness and curvature in metatarsals of *Homo* and *Pan* and implications for hominin foot morphology .** J. MCCLYMONT, T. JASHASHVILI, K.J. CARLSON, B. ZIPFEL.
- 200 **Morphological variation and the role of allometry in the Galagonidae cranium.** G.E. PRICE, C. SOLIGO.
- 201 **Fossil macaque from Middle Pleistocene of Gajtan Cave, Albania, aligns with *Macaca sylvanus* via geometric morphometric analysis.** B.M. SHEARER, E. DELSON.
- 202 **Cranio-facial variation in sub-species of *Pan*.** N. SINGH, K. HARVATI, C. BOESCH.
- 203 **Identification of dietary niche overlap in the primate fossil record using an extant competitive guild.** L.K. STROIK.

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204	<i>Paralouatta</i> , the Cuban enigma: evidence from postcranial morphology. M. TALLMAN, L.B. HALENAR, S.B. COOKE, S. ALMÉCJA.
205	Scaling of jaw-muscle fiber architecture in platyrrhines: a preliminary assessment. A.B. TAYLOR, T. YUAN, C.F. ROSS, C.J. VINYARD.
206	Ontogenetic variation in the ascending ramus of great apes and humans. C.E. TERHUNE, C.A. ROBINSON, T.B. RITZMAN.
207	Small mammal assemblages from the Chadron Formation of Nebraska and implications for understanding late Eocene primate community ecology. M.A. TORNOW, T.C. ARBOR.
208	Climate change and the behavioural ecology of <i>Propithecus coquereli</i> in northwest Madagascar . S.S. TRAVIS, K.C. MCGOOGAN, S.M. LEHMAN.
209	Comparative anatomy of the lower limb muscles of hominoids: attachments, relative weights, innervation, functional morphology and evolution . E. INFESTAS, J. PASTOR, R. DIOGO, B. WOOD.

Saturday. Morning Sessions.

Session 34	BIOARCHAEOLOGY OF CONTACT AND COLONIALISM. Invited Podium Symposium. <i>Galleria North</i>. Chair: Melissa S. Murphy and Haagen D. Klaus
	This symposium is organized around the topic of bioarchaeology of contact and colonialism and proposes to convene participants to discuss and compare current issues in bioarchaeological research of colonial encounters and contact after the 16th Century from different areas of the world. Colonial encounters and cultural contact had profound transformative effects that can be discerned from the material record. Bioarchaeological studies of colonialism often focus on the experiences of the colonized or native peoples or the dichotomous relationship between the colonizer and the colonized, but considerable study has shown that native experiences were considerably varied and that the effects of colonialism were not only felt by indigenous groups, but also by the colonizers themselves and that these effects may have altered the relationships between indigenous groups. Some possible topics discuss the biocultural impact of health on indigenous peoples, violence and warfare, paleodemography and the formation of hybrid and different identities (native, colonizer, mestizo, etc.) from a bioarchaeological perspective, the nature of 'indigeneity' and the process of ethnogenesis, paleodemography and population dynamics, as well as the nuances of meaning in shifting mortuary patterns after colonialism. Rather than focusing on one hemisphere or one region, we have invited participants that work in many different areas of the world and the symposium has considerable global representation.
8:00-8:15	Surfacing from the Wake of Conquest: regional diversity in biocultural responses to European colonization in Northern Peru. H.D. KLAUS, R.V. ALVAREZ-CALDERÓN.
8:15-8:30	Population health in the early colonial <i>reducción</i> of Magdalena de Cao Viejo . C.M. GAITHER, M.S. MURPHY, J. QUILTER, C. BREZINE, R. FRANCO.
8:30-8:45	A bioarchaeological approach to interethnic contact in Tierra del Fuego, Argentina (19th-20th centuries). R.A. GUICHÓN, P. GARCÍA LABORDE, M. SALERNO, R. CASALI, R. GUICHÓN.
8:45-9:00	New research on the Colonial Period Maya Cemetery at Tipu, Belize. M.N. COHEN, M. DANFORTH, N. ELWESS, J. SABINO.
9:00-9:15	Physiological stress in a multi-ethnic cemetery population from colonial Campeche, Mexico. A. CUCINA, M. RODRIGUEZ, V. TIESLER.
9:15-9:30	Survival and abandonment of indigenous head shaping practices in the Colonial Andes and Mesoamerica . V. TIESLER, P. ZABALA.
9:30-9:45	Sugar, health, and slavery: forty years of bioarchaeological research at Newton Plantation, Barbados. K.A. SHULER, H. SCHROEDER, W. STEVENS, K. HERNDON.
9:45-10:00	Reconstructing health at Elmina, Ghana: bioarchaeological perspectives of a historic African settlement in the Atlantic world . E. S. RENSCHLER, C.R. DECORSE.
10:00-10:15	Break

Saturday April 14th, 2012 Morning Sessions

10:15-10:30	The legacy of slavery and trade: morphometric assessment of 18th populations dynamics at the Cape of Good Hope. I. RIBOT, A.G. MORRIS.
10:30-10:45	The social structuring of stress in contact-era Spanish Florida: a bioarchaeological case study from Santa Catalina de Guale, St. Catherines Island, Georgia. L.A. WINKLER, C.S. LARSEN, V. THOMPSON, P.W. SCIULLI, D.L. HUTCHINSON.
10:45-11:00	La fin du voyage: the French Colonial experience in the Americas. D.N. COOK, J.L. FUNKHOUSER, M.E. DANFORTH, B.T. HESTER.
11:00-11:15	Are bound feet an expression of Chinese ethnic identity during the Manchurian-ruled Qing Dynasty (1644-1911)? . C. LEE.
11:15-11:30	The interpretation of shifting mortuary patterns after contact and colonialism. M. BOZA CUADROS, M.S. MURPHY, C. GAITHER.
Session 35	THE OTHER FAUNIVORY: THE SIGNIFICANCE OF INSECTS AND INSECT RESOURCES FOR NONHUMAN PRIMATES, MODERN HUMANS AND EXTINCT HOMININS. Invited Podium Symposium. <i>Galleria South.</i> Chair: Robert C. O'Malley and William C. McGrew
	<p>The earliest primates are hypothesized to have been predators on small animals, including insects. Today, insects are consumed (to varying degrees) by humans and all species of great apes. Inferences from the behavior of modern hunter-gatherers and African apes, analyses of hominin dental isotopes, and tool microwear studies suggest that insects and insect resources were consumed by some extinct hominins as well. There is broad recognition that greater exploitation of animal-source foods was significant in the evolution of the genus <i>Homo</i>, and that carnivory is both difficult and risky. However, the significance of insectivory (as well as predation on other invertebrates such as shellfish) has received comparatively little attention as an alternative or complimentary strategy to hunting. This symposium brings together scientists from the fields of primatology, evolutionary anthropology, paleontology, archaeology, nutritional ecology, and entomology to present research on the exploitation of insects and insect resources by living primates, modern humans and extinct hominins. The symposium will conclude with a discussion of unresolved questions and possible directions for further research.</p>
8:00-8:15	The way of all flesh? 'The other faunivory' revisited. W.C. MCGREW.
8:15-8:30	The nutritional contribution of insects in the diets of modern humans: a geometric analysis. D. RAUBENHEIMER, J.M. ROTHMAN.
8:30-8:45	Nutritional contributions of insects to primate diets. J.M. ROTHMAN, D. RAUBENHEIMER.
8:45-9:00	Tarsiers and the stable isotope ecology of primate faunivory . G.L. MORITZ, N.J. DOMINY.
9:00-9:15	Seasonal variation in capuchin insectivory and invertebrate abundance. A.D. MELIN, K.N. MOSDOSSY, H.C. YOUNG, L.M. FEDIGAN.
9:15-9:30	Insect prey characteristics affecting regional variation in chimpanzee tool use. C. SANZ, I. DEBLAUWE, N. TAGG, D. MORGAN.
9:30-9:45	The caloric and nutritional yields from insectivory for Kasekela chimpanzees. R.C. O'MALLEY, M.L. POWER.
9:45-10:00	'The other faunivory' at Semliki, Uganda: is there evidence for a 'savanna chimpanzee' pattern of insectivory?. T.H. WEBSTER, W.C. MCGREW, L.F. MARCHANT, C.L. PAYNE, K.D. HUNT.
10:00-10:15	Break
10:15-10:30	Energetics and biomechanics of humans climbing trees for honey . V.V. VENKATARAMAN, T.S. KRAFT, W.K. HEPPENSTALL, A.J. CUNNINGHAM, N.J. DOMINY.
10:30-10:45	Honey, hunter-gatherers, and human evolution. F.W. MARLOWE.
10:45-11:00	Mammalian faunivores: prey, foraging, and microwear. S.G. STRAIT.
11:00-11:15	Termites and bone tools: implications of termite genera on the foraging behavior of the Swartkrans hominins. J.J. LESNIK.
11:15-11:30	Fighting back: how solitary and social insects have responded to attacks by insectivores and overwhelmingly powerful predators. J.O. SCHMIDT.
11:30-11:45	Discussion

 Saturday April 14th, 2012 Morning Sessions

11:45-12:00	Discussion
Session 36	PALEOANTHROPOLOGY: LATE PLEISTOCENE. Contributed Podium Presentations. <i>Grand Ballroom II.</i> Chair: Sang-Hee Lee
8:00-8:15	Middle Pleistocene human facial morphology. S.E. FREIDLINE, P. GUNZ, K. HARVATI, J. HUBLIN.
8:15-8:30	Anterior tooth root morphology in Neanderthals and anatomically modern humans: quantification and functional implications. A. LE CABEC, K. KUPCZIK, J. BRAGA, J. HUBLIN.
8:30-8:45	3D reconstruction of Regourdou 1 pelvis: estimation of missing parts and first morphometric analysis. V. MEYER, F. SANTOS, B. DUTAILLY, C. COUTURE, J. BRUZEK, B. MAUREILLE.
8:45-9:00	New data from an old site: Neanderthals at Goyet (Belgium) and their mortuary behavior. H. ROUGIER, I. CREVECOEUR, C. BEAUVAL, H. BOCHERENS, D. FLAS, M. GERMONPRÉ, P. SEMAL, J. VAN DER PLICHT.
9:00-9:15	The unique bilateral strength asymmetry and cross-sectional shape of Neanderthal humeri may reflect adaptation to scraping tasks, but not spear thrusting. C.N. SHAW, C.L. HOFMANN, J.T. STOCK, J.S. GOTTSCHALL.
9:15-9:30	Vindija Neanderthals as evidence for gene flow from early modern humans. F.H. SMITH, A.M. WARD.
9:30-9:45	Antemortem tooth loss and longevity in human evolution. C.C. GILMORE, M.N. GROTE.
9:45-10:00	Skull reconstruction of Barma del Caviglione 1, Grimaldi Caves, an Upper Paleolithic <i>Homo sapiens</i>. G. GUIPERT, A. VIALET, M. DE LUMLEY, H. DE LUMLEY.
10:00-10:15	Endocranial shape in early modern humans . S. NEUBAUER, P. GUNZ, J. HUBLIN.
10:15-10:30	Break
10:30-10:45	Salkhit and modern human origins in northeast Asia. S. LEE, S. YI.
10:45-11:00	Virtual reconstruction of the Lake Mungo 3 skull. M.S. PONCE DE LEÓN, A.C. DURBAND, M.C. WESTAWAY, C.P. ZOLLIKOFER.
11:00-11:15	Modern human fossils from Tam Pa Ling, Laos. L.L. SHACKELFORD, F. DEMETER, A. BACON, P. DURINGER, K. WESTAWAY, T. SAYAVONGKHAMDY, J. BRAGA, P. SICHANTHONGTIP, P. KHAMDALAVONG, J. PONCHE, C. LUNDSTROM, E. PATOLE-EDOUMBA, A. KARPOFF.
11:15-11:30	The origins of dental modernity . S.E. BAILEY, J. HUBLIN.
11:30-11:45	The thumb of <i>Homo floresiensis</i>: first comparative analyses of the proximal and distal pollical phalanges from Liang Bua. I. CREVECOEUR, M.W. TOCHERI, R. DUE AWE, C.M. ORR, S. CARNATION, W.L. JUNGERS.
11:45-12:00	Flores feet, factoids and fairytales. B. ECKHARDT, M. HENNEBERG.
Session 37	HUMAN BIOLOGY. Contributed Podium Presentations. <i>Parlors.</i> Chair: Aaron D. Blackwell
8:00-8:15	Are big primates less hairy? Primate hair and body size revisited . A.A. SANDEL.
8:15-8:30	Social networks and cooperation in Hadza hunter-gatherers. C.L. APICELLA, F. MARLOWE, J. FOWLER, N. CHRISTAKIS.
8:30-8:45	Social proximity and egalitarianism among hunter-gatherers vs. farmers in the Central African Republic. A.H. BOYETTE.
8:45-9:00	The impact of reputation on resource allocation in humans. N.H. HESS, E.H. HAGEN.
9:00-9:15	Women living with parents-in-law are more fertile. G. JASIENSKA, I. NENKO, A. GALBARCZYK, M. JASIENSKI, M. WALAS.
9:15-9:30	How social is inequity aversion in humans? Like nonhuman primates, children reject inequity in a nonsocial game. K. MCAULIFFE, P.R. BLAKE, G. KIM, R. WRANGHAM, F. WARNEKEN.

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9:30-9:45	Education and marital status are protective against active tuberculosis in Monterrey, Mexico . B.N. YOUNG, A. RENDON, A. ROSAS-TARACO, A. HANDAL, J. BAKER, J. LONG, M. BURGOS, K. HUNLEY.
9:45-10:00	Reductions in helper T-cells and increases in natural killer cells are associated with poorer growth in an indigenous Amazonian population. A.D. BLACKWELL, I. MALDONADO SUAREZ, J. STIEGLITZ, M. GURVEN, H. KAPLAN.
10:00-10:15	Dark days: the 1907 epidemic on Inishark, Co. Galway Ireland. P.R. LETTIERI, I. KUIJT, B. RIDENHOUR.
10:15-10:30	Break
10:30-10:45	Obtaining quantitative life history predictions from serial growth data. M.H. MCINTYRE.
10:45-11:00	Estimation of biological sex from activity patterns for subadult skeletal remains from the Windover and Indian Knoll Archaic populations. G.P. THOMAS.
11:00-11:15	Will it be a boom or a bust: the last fifty years of juvenile research in physical anthropology and implications for future research. R. SCOPA KELSO.
11:15-11:30	Ontogeny of sexual size dimorphism and environmental quality in Guatemalan children. D. NIKITOVIC, B. BOGIN.
11:30-11:45	Monkeys on the menu? reconciling patterns of primate hunting and consumption in a central African Village. C.A. JOST ROBINSON, L.L. DASPIT, M.J. REMIS.
11:45-12:00	Nicotine — candy or cure? A longitudinal study of smoking vs helminth reinfection among African hunter-gatherers. E.H. HAGEN, C. ROULETTE, D. MONCHY, R.J. SULLIVAN, J. WILCOX, M. REMIKER.

**Session
38****STORIES FROM THE SKELETON: HARD TISSUE RESEARCH ON MODERN, NON-HUMAN PRIMATES.** Invited Poster Symposium. *Forum Suite.*

Chair: Claire A. Kirchhoff and Scott S. Legge

7:30-8:00 am Poster set-up

11:00-11:30 am Poster take-down

Investigating other primates as a means of gaining insight into the human condition has a long tradition in anthropology, with Louis Leakey as one of its most influential proponents. Certainly the last several decades have seen great leaps in our knowledge of the biology, ecology, and life histories of some of our closest relatives. How we relate behavioral data to that fundamental source of information on human evolution, the fossil record, relies heavily on hard tissue research. Skeletal analysis is crucial both to our understanding of an entire organism as well as for making reasonable inferences about the fossil record, where hard tissue may provide the only line of evidence. The skeletal biology of modern, non-human primates is therefore of particular interest to anthropologists, who seek both to understand primates as a clade and to examine human nature through the lens of humans as primates. While this symposium brings together scholars employing disparate methodologies, studying numerous different species, and asking a variety of key questions, they are all engaged in research on the skeletons of modern, non-human primates, exploring what this type of research can tell us about the life ways of these fascinating animals.

1	Development of sexually dimorphic traits beyond dental maturity in the cranium of <i>Gorilla gorilla</i>. K.L. BALOLIA, C. SOLIGO.
2	Growth and development of the hominoid shoulder girdle: can ontogeny tell us about locomotor ancestry?. A.P. BARROS.
3	Cortical bone density determined with microCT in the chimpanzee and gorilla facial skeletons . P.C. DECHOW, L.C. SMITH, C. CHOATE, B. CURTIS.
4	Capuchin postcranial adaptations. S.M. FORD, K.A. WRIGHT, B.W. WRIGHT, D.G. HOBBS.
5	Mapping the great apes: application of non-metric traits in the deciduous teeth of <i>Gorilla</i> and <i>Pan</i>. A.M. HARDIN, S.S. LEGGE.
6	Differences between eastern and western gorillas in the forelimb and hindlimb skeletons. R. JABBOUR.
7	Antemortem tooth loss, tooth wear, and dental trauma: Learning more from the Gombe chimpanzees. C.A. KIRCHHOFF.
8	Sex-related patterns of dentoalveolar abscesses in the genus <i>Pan</i>. S.S. LEGGE.
9	Trabecular bone architecture in supraorbital region of <i>Homo</i>, <i>Pan</i>, <i>Gorilla</i>, <i>Papio</i>, and <i>Cebus</i>. L.C. PRYOR SMITH, P.C. DECHOW.

 Saturday April 14th, 2012 Morning Sessions

Session 39	<p>THE USE OF MODELS IN ANTHROPOLOGICAL LOCOMOTOR BIOMECHANICS: “STAND-INS” OR BASES OF COMPARISON?. Invited Poster Symposium. <i>Alexander's</i>.</p> <p>Chair: Kristiaan D'Aout and Gilles Berillon</p> <p>7:30-8:00 am Poster set-up 11:00-11:30 am Poster take-down</p> <p>Most crucial issues with respect to the hominin locomotor system and its evolution (such as the evolution of habitual bipedalism) cannot be directly investigated, as the available material consists of rare and fragmentary bones and few ichnofossils (e.g. footprints). As in many domains in anthropology, “model” species have, therefore, been used in locomotor studies, with the hope of elucidating specific issues, as well as general principles. However, no extant species can serve as a perfect “stand-in” for an extinct species, despite a close resemblance phylogenetically or morphologically. The present symposium aims to bring together researchers active in biomechanical anthropology (or anthropological biomechanics) focusing on locomotion. In their work, some of them have been focusing on a few species, attempting to obtain fine details of their biomechanics and (carefully) apply them to extinct hominins. Others have been studying a range of species (often less closely related, including non-primates) in a broader comparative approach. Researchers will present their most recent work, especially that which uses alternative species and state-of-the-art experimental methods. In this sense, the “model” used can also be an in vitro model or a computer model. Computer models also can be as precise as possible (i.e. aiming for a good mimic) or more simple, aiming at general insights. The aim of the symposium is to brain-storm on the issues inherent to working with “models”, and to try and find a consensus on future directions that should enable us to extract the best possible and most useful information of experimental and in-silico work on hominin and non-human primate locomotion.</p>
1	Investigating load-carrying in non-human primates: the case study of infant-carrying in Olive baboons. G. BERILLON, Z. ANVARI, K. D'AOÛT.
2	The functional and ecological morphology of terrestriality in Primates and Non-Primate mammals. M.R. BORTHS, A.D. GOSSELIN-ILDARI, B.A. PATEL.
3	Modeling joint loads in bipedal and quadrupedal marsupials and primates: insight into the uniqueness of modern humans. K.J. CARLSON, B.A. PATEL, K. HOUGHTON, M.C. WESTAWAY.
4	The musculoskeletal system of humans is not tuned to maximize the economy of locomotion. D.R. CARRIER, C. ANDERS, N. SCHILLING.
5	The transition between quadrupedal and bipedal gait in hominoid and cercopithecoid models. K. D'AOÛT, P. AERTS, J. GOYENS, G. BERILLON.
6	Sheep in shoes: a new experimental test of Wolff's Law of trabecular orientation. D.E. LIEBERMAN, M. BARAK, J. HUBLIN.
7	The pendular movement in brachiation: A simple model for a locomotion system used in complex environments. F. MICHILSENS, K. D'AOÛT, E.E. VEREECKE, P. AERTS.
8	A model-based approach to compute 3D bipedal locomotion based on anthropological data – application to non-human primates and early hominids . G. NICOLAS, F. MULTON, G. BERILLON.
9	Chimpanzee bipedalism: integrating experiments and musculoskeletal modeling . M. O'NEILL, B. DEMES, N.E. THOMPSON, S.G. LARSON, J.T. STERN, JR., L. LEE, B.R. UMBERGER.
10	Investigating causal relationships among morphology, kinematics and energetics of bipedal locomotion using musculoskeletal models: forward and inverse dynamic approaches. N. OGIHARA, N. IDE, M. HAMANO, M. NAKATSUKASA.
11	Using musculoskeletal simulations to model the cost of locomotion: the OpenSim experiment. M. OUCHIDA, A.D. SYLVESTER, P.A. KRAMER.
12	Relating foraging ecology to locomotor economy and limb length in living apes and fossil hominins. H. PONTZER.
13	Using modern taxa to understand biomechanical variables: Interpreting function from fossil footprints. B.G. RICHMOND, K.G. HATALA, H.L. DINGWALL, R.E. WUNDERLICH.
14	Modeling hominin swing phase mechanics using humans, chimpanzees, and other primates. D. SCHMITT, R.E. WUNDERLICH.
15	The origin and evolution of primate quadrupedalism: insights from marsupials. L.J. SHAPIRO, J.W. YOUNG, J.L. VANDEBERG.

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16	GRF moment arms about the knee in A.L. 288-1. A.D. SYLVESTER, K. D'AOÛT, P.A. KRAMER.
17	Human hand function and dysfunction: what insights can be gained from comparative anatomy and musculoskeletal computer models?. E.E. VEREECKE, F. KERKHOF, F. STOCKMANS, I. JONKERS, S. VAN SINT JAN.
18	Is female morphology selected for economy and male morphology selected for efficiency? Evidence from studies on humans. C.M. WALL-SCHEFFLER, M.J. MYERS.
19	Inferring hominin activity levels from limb bone remains: insights from a mouse model. I.J. WALLACE, S.M. TOMMASINI, S. JUDEX, T. GARLAND JR., B. DEMES.
20	Discussant, D. Schmitt

Saturday. Afternoon Sessions.

Session 40	FUNCTIONAL SKELETAL BIOLOGY. Contributed Podium Presentations. <i>Galleria North</i>. Chair: Fred L. Bookstein
1:00-1:15	A future for morphometrics in anthropology. F.L. BOOKSTEIN.
1:15-1:30	Carrying loads using bamboo poles: a potential method for reducing the metabolic cost of carrying. E.R. CASTILLO, G. FRANKEL, D.E. LIEBERMAN.
1:30-1:45	Comparative anatomy, evolutionary trends and the myth of human morphological complexity: empirical studies reveal that modern humans have fewer muscles than most primate and non-primate mammals. R. DIOGO, E. INFESTAS, B. WOOD.
1:45-2:00	What can muscle insertions tell us about activity during life? Functional anatomy and development of the deltoid tuberosity in wild-type mice. K. RABEY, D.J. GREEN, S.C. MCFARLIN, D.R. BEGUN, B.G. RICHMOND.
2:00-2:15	Do food material properties impact mandible morphology in primates?. C.F. ROSS, J. IRIARTE-DIAZ.
2:15-2:30	Remodeling in bones of the human hand and its relationship to loading. M.S. DRAPEAU, É. RAGUIN, J. PURCELL, R.A. LAZENBY, M.A. STREETER.
2:30-2:45	Proposal and validation of definitions for intact and fragmented osteons. J.T. HEINRICH, C.M. CROWDER, D.C. PINTO.
2:45-3:00	Directional shifts in humeral cross-sectional asymmetry during ontogeny. E.M. GAROFALO, C.B. RUFF.
3:00-3:15	Break
3:15-3:30	Revisiting the human obstetrical dilemma: effect of pelvic rotation stride length. K.K. WHITCOME, J. LOPEZ, E.E. MILLER, J.L. BURNS.
3:30-3:45	Human pelvic geometry in relation to body size and proportionality. H.K. KURKI.
3:45-4:00	Biomechanics of spear throwing, with implications for fossil hominins. J.M. MAKI.
4:00-4:15	The hominin heel process and the human lateral plantar tubercle. E.E. SARMIENTO.
4:15-4:30	The effects of physical activity and health status on bone strength development. C.D. ELEAZER.
4:30-4:45	Are all humans created equal? A multivariate approach to skeletal asymmetry. E.M. FRANKS, L.L. CABO.
4:45-5:00	Primates are all brain and little brawn: a preliminary investigation into tissue tradeoffs. M.N. MUCHLINSKI, L. NEVELL, R. DIOGO, J.J. SNODGRASS.

 Saturday April 14th, 2012 Afternoon Sessions

Session 41	ADVANCES IN UNDERSTANDING ORAL HEALTH PRESENT AND PAST: INTERDISCIPLINARY INSIGHTS ON SEX AND GENDER DIFFERENCES. CO-SPONSORED BY THE AAPA/DENTAL ANTHROPOLOGY ASSOCIATION. Invited Podium Symposium. <i>Galleria South</i>. Chair: John R. Lukacs, Stefanie L. Russell, and Alexandre Vieira
	Anthropologists study dental diseases in ancient people to better understand food preparation methods and dietary patterns through time with the goal of uncovering important differences in behavior by sex, subsistence, and social status. Inter-disciplinary collaboration in the study of oral health is critical to advancements in understanding the complex genetic, environmental and cultural causes of dental diseases in populations past and present.
	This symposium is designed to foster the interdisciplinary exchange of current research in dentistry, epidemiology, and biological anthropology. Advances in the genetics of dental caries and epidemiology of oral pathology will be presented together with new approaches to the diagnosis of dental disease in prehistory and the interpretation of variation in oral health in ancient societies. This symposium is unprecedented in the range of disciplines participating and the potential for significant interchange of ideas and insights.
1:00-1:15	Genetics of caries. A.R. VIEIRA.
1:15-1:30	Caries in the primary and permanent dentitions. M.L. MARAZITA, J.R. SHAFFER, E. FEINGOLD, X. WANG, S.M. LEVY.
1:30-1:45	Twin brothers and sisters. Do they all floss?. W. BRETZ.
1:45-2:00	Genetic association of taste receptor pathways, caries and gender variations. S.K. WENDELL, X. WANG, M. BROWN, R.S. DESENSI, R.J. WEYANT, R. CROUT, D.W. MCNEIL, M.L. MARAZITA.
2:00-2:15	Is motherhood bad for oral health? Effects of parity on periodontal disease, caries and tooth loss in US women. S.L. RUSSELL.
2:15-2:30	The relationship between height and dental caries – a life course perspective. B.F. NICOLAU.
2:30-2:45	Relationships of gender and socioeconomic status with dental caries and early childhood malnutrition in Haitian children. W.J. PSOTER.
2:45-3:00	Sex differences in carious lesions in modern Maya populations: food consumption or else?. E.M. VEGA LIZAMA, A. CUCINA.
3:00-3:15	Meta-analyses reveal direction and timing of sex and gender differences in oral health. J.R. LUKACS.
3:15-3:30	Break
3:30-3:45	Sex differences in periodontal disease and caries in a Portuguese identified skeletal sample from the late nineteenth and early twentieth centuries. S.N. WASTERLAIN.
3:45-4:00	Male-female oral health differences in early Chinese communities. E. PECHENKINA, W. FAN, X. MA.
4:00-4:15	Interpreting sex differences in dental caries among prehistoric Late/Final Jomon period people from Japan: regional perspectives on dietary variation and reproductive ecology. M.T. KERR, D.H. TEMPLE.
4:15-4:30	The aetiology of oral disease: a differential diagnosis based on the mainland Southeast Asian experience. M.F. OXENHAM, A. WILLIS.
4:30-4:45	Predictors of death: A life-history approach for understanding oral health patterns during the late prehistoric period in the Eastern Woodlands. J.J. WILSON.
4:45-5:00	The interaction of reproductive physiology and biocultural ecology: a comparison of prehistoric oral pathology in two American deserts. J.T. WATSON.
5:00-5:15	Discussant, S. HILLSON
Session 42	PRIMATE BEHAVIOR: REPRODUCTION AND LIFE HISTORY. Contributed Podium Presentations. <i>Grand Ballroom II</i>. Chair: James P. Higham
1:00-1:15	Paternal kin recognition in female, captive, grey mouse lemurs (<i>Microcebus murinus</i>). S.E. KESSLER, M. SCHEUMANN, L.T. NASH, E. ZIMMERMANN.

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1:45-2:00	Variation characterizes cooperative infant care in wild variegated lemurs (<i>Varecia rubra</i>) of Masoala, Madagascar. N. VASEY.
2:00-2:15	Testing the immunocompetence handicap hypothesis (ICHH) in both sexes of wild brown mouse lemurs (<i>Microcebus rufus</i>). S. ZOHDY, S. TECOT, P.C. WRIGHT, J. JERNVALL.
2:15-2:30	Social correlates of androgen levels in the siamang (<i>Symphalangus syndactylus</i>). L. MORINO.
2:30-2:45	Evaluating adrenocortical activity in free-ranging rhesus macaques using cortisol from hair. M.V. RAKHOVSKAYA, J. MEYER, M. HEISTERMANN.
2:45-3:00	Enough time to become smart: skill learning in immature orangutans. C. SCHUPPLI, M.A. VAN NOORDWIJK, K. ISLER, C.P. VAN SCHAİK.
3:00-3:15	Skill learning and the duration of development: the role of provisioning. C. VAN SCHAİK, C. SCHUPPLI, S. GRABER, K. ISLER.
3:15-3:30	Break
3:30-3:45	Can male white-faced saki monkeys (<i>Pithecia pithecia</i>) detect female reproductive state?. C.L. THOMPSON, P.L. WHITTEN, M.A. NORCONK.
3:45-4:00	The mating and signaling system of the socially-tolerant crested macaque. J.P. HIGHAM, M. HEISTERMANN, C. SAGGAU, M. AGIL, D. PERWITASARI-FARAJALLAH, A. ENGELHARDT.
4:00-4:15	Group size, age, and reproductive state affect dominance in wild female Hanuman langurs (<i>Semnopithecus entellus schistaceus</i>). C. BORRIES, A. LU, A. CASELLI, A. KOENIG.
4:15-4:30	“Following,” an alternative mating strategy used by male olive baboon (<i>Papio hamadryas anubis</i>): description and outcomes. L.M. DANISH, R.A. PALOMBIT.
4:30-4:45	Variation in hair cortisol in wild anubis and hamadryas baboons and their natural hybrids. N.H. FOURIE, R.M. BERNSTEIN, J.E. PHILLIPS-CONROY, C.J. JOLLY, J.L. BROWN.
4:45-5:00	Growing up gibbon: evidence for direct teaching and social learning in a cooperative breeding ape, the siamang (<i>Symphalangus syndactylus</i>), at the El Paso Zoo. F.G. MCCROSSIN, B.R. BENEFIT.
Session 43	HUMAN AND NON-HUMAN GENETIC VARIATION. Contributed Podium Presentations. Parlors. Chair: Heather J. H. Edgar
1:00-1:15	Aye-aye demography and conservation genomics. G. PERRY, E. LOUIS, S. SCHUSTER, W. MILLER.
1:15-1:30	Genetic evidence of widespread differential selection for color vision among nocturnal lemurs. C.C. VEILLEUX, E.E. LOUIS, D.A. BOLNICK.
1:30-1:45	An integrative approach to understanding primate mating systems: Oxytocin and New World monkeys. D. SPROCKETT, A. MUHLBERGER, M. RAGHANTI, M. NORCONK, C. CHIU.
1:45-2:00	Genetics of social network position in free-ranging rhesus macaques . L.J. BRENT, S.R. HEILBRONNER, J.E. HORVATH, J. GONZALEZ-MARTINEZ, A.V. RUIZ-LAMBIDES, A. ROBINSON, J.P. SKENE, M.L. PLATT.
2:00-2:15	Population recovery and genetic variability in an urban environment: Singapore’s banded leaf monkey population. A. ANG, A. SRIVASTHAN, R. MEIER, B. MD-ZAIN.
2:15-2:30	Viruses on low-carb diets: the possible role of a cell surface carbohydrate in the evolution of resistance to viral infections in catarrhines. I.A. RODRIGUEZ, U. GALILI, L.R. GODFREY, R.M. WELSH.
2:30-2:45	Metagenomic comparisons of gastrointestinal microbial function in hominoids . C.J. YEOMAN, R.M. STUMPF, B.A. WHITE, B.A. WILSON, K.E. NELSON, M. TORRALBA, M. GILLIS, L. MUGISHA, S.R. LEIGH.
2:45-3:00	Craniofacial phenotypic variation in craniosynostosis syndromes: the face makes the difference. Y. HEUZÉ, N. MARTÍNEZ-ABADÍAS, J.M. STELLA, F. DI ROCCO, C. COLLET, G. GARCÍA FRUCTUOSO, M. ALAMAR, L. LO, S.A. BOYADJIEV, J.T. RICHTSMEIER.
3:00-3:15	Break
3:15-3:30	Maximum heritability as an indicator of relative developmental stability among populations. H.J. EDGAR, T. HUGHES, K. RUSK.

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3:00-3:15	Break
3:15-3:30	Maximum heritability as an indicator of relative developmental stability among populations. H.J. EDGAR, T. HUGHES, K. RUSK.
3:15-3:30	Y chromosome diversity in Inupiat populations of the Alaskan North Slope. J. RAFF, M. RZHETSKAYA, M. HAYES.
3:45-4:00	Estimating the evolutionary history of Southeast Asian Ovalocytosis. A.M. PAQUETTE, M.K. THOMPSON, J.H. CHASE, J.A. WILDER.
4:00-4:15	Genome-wide Complex Trait Analysis (GCTA) as a method to quantify missing heritability in Parkinson's disease. M.F. KELLER, M.A. NALLS, A. SINGLETON.
4:15-4:30	Epigenetic alterations and stress among new mothers and infants in the Democratic Republic of Congo: A biocultural look at the intergenerational effects of war. C.J. MULLIGAN, N. D'ERRICO, J. STEES, C.C. GRAVLEE, T.P. YANG.
4:30-4:45	Quantitative genetic analysis reveals trade-offs between age at first reproduction and fertility. J.H. JONES.
4:45-5:00	Grandfather's age at father's birth is associated with longer telomere lengths in grandchildren in the Philippines: a case of adaptive intergenerational signaling?. D.T. EISENBERG, J.B. BORJA, M. HAYES, C.W. KUZAWA.
Session 44	<p>BIOARCHAEOLOGY IN WESTERN COASTAL NORTH AMERICA: INTEGRATING STUDIES OF HUMAN PREHISTORY. Invited Poster Symposium. <i>Alexander's (23rd Floor).</i></p> <p>Chair: Sabrina B. Sholts and Eric J. Bartelink</p> <p>1:30-2:00 pm Poster set-up 5:00-5:30 pm Poster take-down</p> <p>Bioarchaeology along the western coast of North America has produced an enormous wealth of information about early human populations of the New World. In few places is the skeletal record longer and more extensive, providing valuable opportunities to investigate temporal and spatial variation in ancient human behavior and adaptation. Understanding the full extent of this variation is a challenge, as much previous research has focused on narrow time frames, site localities, or methodology. The purpose of this symposium is to provide an integrative view of human prehistory across the western coastal North America, incorporating studies of human skeletal remains from multiple locations, including California, Oregon, British Columbia, and Alaska. Presentations will address a variety of topics through cross-regional, diachronic, and multi-disciplinary research, including skeletal and dental health, biomolecular archaeology, and geometric morphometrics. It is becoming increasingly evident that colonization of the New World involved Pacific coastal migration, and that the skeletal remains of these groups and their successors represent a crucial component of the human global story. By integrating new and cutting-edge analyses of ancient humans within a regional context, this symposium is thus relevant to biological anthropological research across the Americas, as well as around the Pacific Rim.</p>
1	Human diet and mortuary patterns in the southeastern San Francisco Bay area: stable isotope analysis of the Ryan Mound population (CA-ALA-329). E.J. BARTELINK, M.M. BEASLEY, M. ATWOOD, K.S. GARDNER, A. LEVENTHAL, R. CAMBRA.
2	Diet, dental health, and food acquisition in the prehistoric San Francisco Bay Area: bioarchaeology of the Ellis Landing Ohlone population . M.M. BEASLEY, E.J. BARTELINK.
3	Patterns of interpersonal violence and warfare in the prehistoric San Francisco Bay Area California. V.I. BELLIFEMINE, E.J. BARTELINK, V.A. ANDRUSHKO, I. NECHAYEV, R. JURMAIN.
4	Why so worn? Tooth wear analysis of the Santa Barbara Channel area Chumash people. A.F. CLEMENT, S.W. HILLSON.
5	Strangers among them: using stable C, N, and S isotope analysis of human bone to interpret four unusual burials at the Yukisma Mound (CA-SCL-38), in Santa Clara County, California . K.S. GARDNER, A. LEVENTHAL, R. CAMBRA, E.J. BARTELINK, A. MARTINEZ.
6	Reading between the vertebrae – the presence of a non-embedded projectile point and subsequent consequences: a case study. D. GRANT, D. DI GIUSEPPE, A. LEVENTHAL, R. CAMBRA.
7	Are coastal diets healthy? Examples from the Northern Pacific Rim. K.C. HOOVER, M. RICHARDS, M. YONEDA.
8	Correlations between nitrogen isotope levels and stature in three Northern California prehistoric groups. D.C. KATZ, J.W. EERKENS, E.J. BARTELINK.

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13 **Human health and hydrocarbon exposure along the prehistoric West Coast.** S.K. WÄRMLÄNDER, S.B. SHOLTS, K. SMITH, R. VELLANOWETH, J.M. ERLANDSON, R. WESTERLUND.

14 **Discussant,** T. JONES

Session 45 EXAMINING THE BIG PICTURE: WORKING TOWARDS A HOLISTIC UNDERSTANDING OF SECULAR CHANGE IN MODERN POPULATIONS. Invited Poster Symposium. *Forum Suite.*

Chair: Natalie R. Shirley, Stephen D. Ousely, and Richard L. Jantz

1:30-2:00 pm Poster set-up

5:00-5:30 pm Poster take-down

Over the past several decades, researchers have documented secular change in stature, skeletal maturation, pubertal onset, and overall skeletal morphology in populations throughout the world. Proposed explanations for these changes center on environmental causes, including improvements in nutrition, healthcare, sanitation, socioeconomic status, as well as reduced incidence of infectious diseases and infant mortality. These environmental improvements have influenced growth and adult morphology, likely relaxing selection. Most studies focus on isolated manifestations of secular change (i.e. a single maturation indicator or biometric variable) and establish a timeframe during which this change occurred. Presumably, multiple components of a biological organism respond to changes in environmental stimuli, thereby making these individual studies part of a larger body of literature documenting important changes in human biology that are the result of a common cause or causes. This symposium will bring together the body of research documenting secular change in modern populations, in order to synthesize the material, develop a timeline, explore the possible cause(s), and work towards a more thorough understanding of this phenomenon. The presentations will center on the skeletal approach to studying secular change because it gives us the ability to develop a more comprehensive picture of changes in that we can evaluate multiple body dimensions beyond just stature and investigate time depths beyond the historical record.

1 **You say adaptation, I say plasticity: defining secular change by examining morphological trends among archaeological groups.** B.M. AUERBACH.

2 **Secular change is context dependent: an example from Portugal.** H.F. CARDOSO.

3 **Secular change in the femoral head in modern Americans.** S. CRIDLIN.

4 **Secular change and the modern human pelvis.** K.R. DRISCOLL.

5 **Cranial change in America: 1815 to 1980.** R.L. JANTZ, L.M. JANTZ.

6 **Secular change in the human innominate: from the 19th to the 20th century.** A.R. KLALES.

7 **Changes in postcranial morphology in modern American Whites.** L. MEADOWS JANTZ, R.L. JANTZ, J.B. DEVLIN.

8 **Secular changes in discrete dental traits on three continents.** S.D. OUSLEY, H.J. EDGAR.

9 **Documented secular change in epiphyseal union timing and dimensions of the clavicle.** N.R. SHIRLEY, S. CRIDLIN.

10 **Secular change in Hispanic crania.** M. SPRADLEY, J.T. HEFNER.

11 **Secular change in the cranial modules of white American males: 1830-1978.** T.E. STOTT, K.L. GRAHAM, M. SPRADLEY.

12 **Secular change in the femur.** D.J. WESCOTT, L. ZEPHRO.

Decimal numbers represent poster session numbers (before the period) and poster number (after the period). For instance, "13.14" is poster number 14 in Poster Session 13. Brackets represent time on a 24-hour clock within a podium session (e.g., "32[16:45]" is a paper at 4:45 pm within Podium Session 32). A number followed by a "(Chair)" indicates a chair for a session, while a number followed by a "(Discussant)" indicates a discussant for a session.

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Abstracts of AAPA Poster and Podium Presentations

Growing old in Ranomafana National Park: locomotor proficiency in young and old *Propithecus edwardsi*.

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Senescence is a phenomenon experienced by aging individuals in many species, including humans. Among non-human primates, reproductive, cognitive, dental, and locomotor senescence have been documented. Therefore, primate models of aging and senescence can provide valuable information that aids our understanding of human aging. To date, however, most aging research has focused on captive individuals in a limited number of species. Our ongoing long-term research project at Ranomafana National Park, Madagascar, seeks to rectify this situation by employing more than 20 years of longitudinal data on identified, known-age wild sifakas (*Propithecus edwardsi*). We analyzed field behavioral data and activity budgets of three age classes (young, <10 years; prime, 10 - 20 years; old, >20 years; N = 42) to test the hypothesis that locomotor proficiency is diminished in aged individuals. Our results demonstrate that older sifakas rest more and travel less than younger sifakas, suggesting that age does indeed reduce locomotor efficiency in this species. Preliminary data suggest that this tendency is accentuated when animals are traveling in steep terrain. This research adds to a growing body of knowledge on senescence in general and on the aging process of wild lemurs in particular. Understanding the factors that affect this species as individuals grow old will help us to better contextualize human senescence, as well as to aid in the conservation of this endangered species.

This research was funded in part by NSF BCS 0721233.

A preliminary report on the behavioral ecology of bald-faced saki monkeys (*Pithecia irrorata*) in southeastern Perú.

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Because *Pithecia* are difficult to habituate, they represent one of the most understudied genera of Platyrrhini (Norconk 2006). Within the pitheciines, data regarding *Pithecia irrorata* are rare. This report on *P. irrorata* is derived from data collected during 275 observational hours in June-August 2008 and October-December 2010 at Centro de Investigación y Capacitación Río Los Amigos (CICRA) in southeastern Peru. We identified six groups (n=24) in 2008 and eight groups in 2010 (n=32). Average group size was 4.00 in 2008 and 3.38 in 2010. The majority of groups contained one adult pair and one to two juveniles or

infants. However, some groups contained more than two adult-sized individuals. Two focal groups utilized an area of 28.68 and 33.50 hectares from 2008-2010, which is within the range reported for sakis (Norconk 2007). The sakis fed on seeds, fruits, flowers, and leaves from 21 genera in 16 families and insects such as termites, ants, and crickets. We recorded 12 intergroup territorial bouts that averaged 40.36 minutes in duration (range 8-65 minutes) and consisted of loud calls, body and tail shaking, piloerection, scent marking, and branch shaking. Adult males were the most active participants, but adult females and juveniles often participated on the periphery. We observed sakis interacting with six other primate species. Interactions averaged 17.88 minutes (range 2-53 minutes) and included coordinated travel and feeding, aggression, and avoidance. These preliminary findings on the behavioral ecology of *P. irrorata* are the first step toward constructing a natural history of the species.

The 'Adjusted Parabolic Index': a revised approach to evaluating osteoporosis in human ribs.

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Osteoporosis is a major health concern in modern society. Over forty years ago, the vertebrae and ribs were suggested to be the first skeletal elements affected by this condition (Epker and Frost 1965), however, recent investigations seem to have omitted the role of bone loss in the rib. The Parabolic Index, first proposed by Epker and Frost (1964), was developed to evaluate the degree of osteoporosis in human ribs. It is based on endosteal expansion, but does not account for intracortical bone loss. The objective of this study is to evaluate the effectiveness of the Parabolic Index in accounting for global bone loss in elderly ribs, and propose and test an Adjusted Parabolic Index that incorporates intracortical porosity.

Thick-sections were prepared from 6th ribs of 10 elderly subjects, and Total Bone Area, Endosteal Area, and Cortical Area were measured from 100x magnification composites of each rib for calculation of the Parabolic Index. An Adjusted Parabolic Index was then calculated by subtracting Intracortical Porosity from Cortical Area in the Parabolic Index formula. Parabolic Index and Adjusted Parabolic Index values were compared and percent error was calculated. Results reveal that two subjects (20%) changed classification from non-osteoporotic to osteoporotic with the adoption of the Adjusted Parabolic Index. Additionally, a mean percent error of 13% existed across all subjects. This suggests that intracortical porosity: 1) does play a role in age-associated bone loss in the rib and, 2) should be accounted for in evaluations of osteoporosis or conclusions may be erroneous.

The application of the geometric mean in forensic analysis as demonstrated using the talus and calcaneus.

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The talus and calcaneus of a recent American population sample (n=118) and an ancient Egyptian population sample (n=25) were evaluated and compared using five measurements for each bone. Univariate and multivariate discriminant analyses indicated that both bones displayed significant sexual dimorphism in each population. The geometric mean of the five measurements was calculated for each bone and relative size indices were created to determine if the differences in measurements between males and females in each population sample were purely one of size, or whether shape differences also played a role. There were no significant shape differences demonstrated between the sexes for each population sample, indicating that size alone was responsible for sexual dimorphism in the talus and calcaneus. This was surprising given that many studies have found differences between men and women in the way they walk. However, using relative size indices, significance differences were found between the American and Egyptian tali and calcanei, indicating shape differences between these two populations. This study has shown that measurement differences in these bones between the sexes within each population are due to size and not shape, and that there are both size and shape differences between population groups that may be used to discriminate one population from another. It is recommended that this size standardization technique using the geometric mean be more widely used in forensic analysis, especially where size dimorphism may obscure underlying shape dimorphism between sexes or between populations.

Age-related patterns in postcranial robusticity.

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Although age-related cortical bone loss affects both sexes, research suggests males display concomitant endosteal and subperiosteal expansion (SPE), resulting in increased cross-sectional rigidity. In females, however, cortical bone loss is not offset by SPE, which may explain higher incidences of bone fracture. In their study of bone structure in prehistoric Pecos Pueblo, Ruff and Hayes (1983) showed that both sexes exhibit femoral SPE and increased rigidity with age, presumably due to high activity levels.

This project investigated whether similar sex and age-related patterns were seen in past European populations using a sample of 1,682 individuals (7,000 BP-early 1900). Cross-sectional properties of midshaft femur and tibia and mid-distal humerus were analyzed. The sample was broken up by sex and age (20-39 and 40+).

Results show femoral medullary area increases with age in both sexes, with no increase in cortical area. Loss of cortical bone is offset by significant gains in subperiosteal area, resulting in increased rigidity in both sexes. This pattern is not seen in the tibia or humeri, the latter actually showing reduced bone rigidity.

This analysis confirms that SPE compensates for age-related bone loss in the femur, maintaining mechanical competence in both sexes. Because mechanical loads stimulate bone remodeling, it is reasonable to conclude that increased physical activity in earlier populations results in increased femoral robusticity with age. However, this relationship may only pertain to weight-bearing bones, evidenced by bilateral declines in humeral robusticity with age. Reasons behind the lack of change in the tibia remain unclear.

This study was funded by NSF grant number 1124775 and NSF grant number 0642297.

Investigation of intra-site cranial morphological variation at Sully (39SL4) using geometric morphometry.

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This study uses geometric morphometric methods in conjunction with standard statistical analyses of craniofacial morphology to investigate possible explanations for the presence of multiple, geographically distinct burial areas associated with the Sully village site (39SL4) in the Middle Missouri region of South Dakota. In particular, three burial areas at Sully (A, D, and E) provide adequate samples for assessing intra-site variation. Although, European items are present in burials from each of these cemetery areas at approximately equal rates, it has been assumed that temporal variation may account for the geographically discrete areas. Previous studies utilizing both craniometrics and coordinate data have provided contradictory results regarding proposed temporal ordering of these burial areas. For this study, three dimensional coordinate data from 27 cranial landmarks from 70 Sully burials attributed to the Extended Coalescent and 131 burials from Extended Coalescent and Post-contact Coalescent cemeteries associated with the Moberly site (39WW1) are examined to assess

the variation among the burial areas and to test for a temporal sequence. The coordinate data were translated, rotated and scaled via generalized Procrustes analysis permitting the inclusion of both males and females in the samples and fitted coordinates were subjected to principal component analysis. Canonical variate analysis of the principal components indicates that morphological variation among the Sully burial areas is statistically significant and when compared to the Extended Coalescent and Post-contact Coalescent samples from Moberly, a possible temporal sequence becomes apparent.

Inferences of human adaptive evolution from next-generation sequencing data.

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Identifying regions of the human genome that have been targets of adaptive evolution will provide important insights into recent human evolutionary history. To date, most genome-wide analyses of selection have been performed using highly ascertained SNP markers, which complicates population genetics inferences and the identification of adaptive alleles. Next-generation sequencing technology is a powerful new approach for generating massively large unbiased collections of DNA sequence variation, which will facilitate deeper insights into where and why positive selection has acted on the human genome. Here, I describe genome-wide scans for selection in whole-genome sequences from over 40 geographically diverse individuals and exome sequences obtained in over 2,400 individuals of European and African ancestry. In addition to gene-centric analyses, we have also developed novel approaches to characterize adaptively evolving pathways. Collectively, these analyses have identified hundreds of novel genes and pathways that have strong signatures of selection, refined the location of putatively adaptive alleles, and provided new insights into the historical forces that have shaped recent human history.

This work was funded in part by NIH grants RO1GM078105 and HG005651.

New dental hominoid remains from the Late Miocene locality of Can Llobateres 1 (Vallès-Penedès Basin, Catalonia, Spain).

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Excavations at the Late Miocene (9.7 Ma) locality of Can Llobateres 1 (CLL1; Vallès-

Penedès Basin, Catalonia, Spain) were resumed in 2010, by focusing on the removal of sterile sediments overlying the potentially hominoid-bearing levels with the aid of an excavator machine. Although no hominoid remains were recovered, these works provided additional surface to be manually excavated in the western sector of the site, further leading to the recovery of plant remains that enabled reconstructing the paleoenvironment of *Hispanopithecus laietanus*.

Systematic manual excavations were recently carried out in 2011, both in the eastern (classical) sector and in the new, western sector of CLL1. Although the various levels excavated were not particularly rich, after five weeks of fieldwork, 11 teeth of *H. laietanus* were recovered: a deciduous upper premolar from layer CLL1.1b, in the eastern sector; and 10 upper teeth from layer CLL1.2 (=CLL1.0), in the western sector. The latter teeth were found scattered over a surface of several square meters, and most of them (including incisors, premolars and molars) probably belong to a single individual. These finds represent a significant addition to the sample of dentognathic remains from CLL1, which in the future will contribute to a more complete assessment of intraspecific dental variability in this fossil hominoid. These results unambiguously confirm that the layers of CLL1 rich in fossil primate remains are not exhausted, thus being very promising for the find of additional remains of *Hispanopithecus laietanus* in the future.

This work has been supported by the National Geographic Society (fieldwork grant #8910-11), the Generalitat de Catalunya (fieldwork grant 61636/2010, 2009 SGR 754 GRC, and BP-A 00226 to SA), and the Spanish Ministerio de Ciencia e Innovación (CGL2008-00325/BTE, CGL2010-21672/BTE, RYC-2009-04533 to DMA, and JCI-2010-08241 to ICV).

Fetus into child: comparison of three methods for age estimation in young non-adults from Punta Teatinos, Chile.

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Paleodemography aspires to accurately reconstruct the age structure of skeletal populations, and to provide estimations of past groups' adaptive ability. Questions regarding the accuracy of age estimations (Bocquet-Appel and Masset 1982) have been addressed using a variety of statistical tools (Piontek and Weber 1990; Konigsberg and Frankenberg 1994; Hoppa and Vaupel 2002; Adams and Konigsberg 2004). Age determination in non-adult remains is subject to reference sample bias and unknown inter-population variation in the rate of skeletal development (Bocquet-Appel and Masset 1982; Tocheri and Molto 2002). The differentiation of fetal, neonatal, infant and child remains is especially difficult given the lack of population-specific standards. To assess the accuracy of age determination techniques, non-adult individuals (n=14) from the archaeological site Punta Teatinos (Chile), were aged based on dental development (dental age; Smith 1991; Ubelaker 1978) and linear growth (basisciput and

maximum diaphyseal length; Ghantus 1951; Maresh 1970; Fasekas and Kosa 1978; Scheuer et al. 1980; Scheuer and MacLaughlin-Black 1994). Age estimations were classified as fetal (≥ 40 fetal weeks), infant (0-1 year), child I (2-6 years) and child II (6-12 years). Comparisons indicate that the methods are congruent (dental/basiocciput=90.0%; dental/maximum length=84.6%; basiocciput/maximum length=90.6%). Age estimations diverge more at times of transition –fetus/infant and child I/child II stages. Discrepancies at these transitions may result from increased variability due to adaptive responses at these critical periods (Hochberg 2009). Discrepancies between age estimations increased at more advanced ages, which is in agreement with the expectations regarding the robusticity and sensitivity of dental and linear growth respectively.

A structured approach to human population variation: the application of model-based clustering to world-wide craniometric data.

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The patterned distribution of human craniometric variation remains a topic of considerable anthropological debate. In recent years, population-specific information has been increasingly used in classification-based studies that emphasize the practical utility of ancestry or race for forensic identification in medico-legal contexts. The value of this research has been often overshadowed by theoretical disagreements over how human variation is distributed and methodological debates over how skeletal populations are defined, how group-differences are revealed and how allocations of membership are made. Many of these analyses have been constrained by limited reference samples and criticized for adopting statistical techniques that are user-guided and require *a priori* information.

This project engages these concerns as they relate to the global distribution of human craniofacial variation. The unsupervised clustering methods of finite mixture analysis are implemented as an alternative, user-free approach. These probabilistic, model-based methods allow for rigorous tests of population-specific differences in craniofacial shape and the presence of cryptic, but detectable, population structure, without the need for predefined group-identifiers and comparative samples. This project considers the Howells (n=2,504) and Hanihara world-wide craniometric datasets (n=11,757). Their extensive documentation, large sample size, geographic breadth, and density of sampling enable multi-level tests of population structure. This project demonstrates that a meaningful relationship between statistically inferred clusters and predefined groups exists and that population-informative differences in cranial morphology are detectable with measured degrees of statistical certainty, even when true memberships are unknown. These findings support the presence of population structure and the validity of classification methods as reliable tools.

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Sizing up Madagascar: trends in body mass evolution for five clades of Malagasy mammals.

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The “island rule” stipulates that large mammals that colonize islands will become smaller and small mammals will become larger, though the legitimacy of this supposed trend has been called into question by several researchers. The island of Madagascar presents an interesting opportunity to witness long-term trends in body mass following biological colonization events and to assess the efficacy of the “island rule” on larger islands.

We collected all available measurements of body mass for extant representatives of five Malagasy clades (Tenrecidae, Eupleridae, Nesomyiinae, Miniopitridae, and Lemuroidea), as well as body mass estimates for the extinct members of Lemuroidea. We then used generalized least squares to reconstruct ancestral body masses at each phylogenetic node for all five taxa, and we also estimated ancestral body masses for Lemuroidea using Markov chain Monte Carlo methods based on trees generated by the 10kTrees Project. The differences between the reconstructed ancestral colonizers’ body masses were compared at each node to their descendants’ body masses and plotted over time.

Contrary to the outcome predicted by the “island rule”, the results indicate that most of these clades produce both dwarves and giants relative to the ancestral body mass, although dwarf nodes tend to be comparatively overrepresented. Tenrecidae presents an exception to this observation as it shows a notable trend towards dwarfism. Future research can benefit from the use of temporally sensitive evolutionary models across sympatric taxonomic groups as they can help pinpoint parallel trends in times suggesting habitat-wide environmental change.

Brain size and endocranial morphology of *Antillothrix* (Holocene, Dominican Republic, Hispaniola).

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A cranium of *Antillothrix*, from the underwater cavern of Padre Nuestro (Dominican Republic, Hispaniola), preserves a remarkably detailed endocranium. A virtual endocast was reconstructed from CT images (interslice spacing=0.062mm) using the imaging software Avizo. Virtual endocasts of extant atelids, pitheciids, and cebids were constructed for shape comparisons.

The endocranial volume (ECV) of *Antillothrix* is 40.58cm³. The geometric mean (geomean) of 13 craniodental dimensions, highly correlated to body mass in extant platyrrhines ($r^2=0.95$), indicates a body size comparable to extant *Cacajao* and *Cebus* (3.3kg, 95% CI=2.1 to 5.6kg). Residual ECV, calculated from a linear regression of logECV on logGeomean, is -0.11. This falls within the extant platyrrhine distribution (-0.29 to 0.25), but well below that of similarly sized extant platyrrhines (*Cacajao*=0.18, *Cebus*=0.14). Residual ECV is most comparable to *Saguinus* (-0.12) or *Aotus* (-0.15); however, the endocast differs markedly from these taxa in overall shape. In lateral profile, the frontal lobe has a vertically oriented rostral aspect, and dorsally flattened endovortex as in *Alouatta*. This is unlike the receding frontal lobe profile of *Aotus* or *Saguinus*, or the gently sloping profile of *Saimiri*. The *Antillothrix* endocast is less globular than that of pitheciids, and lacks the elongate fronto-occipital pole seen in *Saimiri*. Basicranial flexion is similar to comparably encephalized extant platyrrhines. The moderately large olfactory bulbs project rostrally and taper distally. The relative breadth of the olfactory fossa is greater than most extant platyrrhines, except *Aotus*. The relative size of the optic foramen is well within the modern diurnal haplorrhine range.

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3D geometric morphometric analysis of the hamate in extant hominoids.

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Accurately quantifying the complex shapes of wrist bones is a major challenge for studies of hominoid functional morphology. Understanding the relationship between wrist morphology and locomotor and manipulative behaviors in extant taxa is a prerequisite for reliably reconstructing the behaviors of extinct hominoids. Here we explored hamate functional morphology among humans, great apes, and gibbons using 3D geometric morphometrics. 3D models of 156 specimens were acquired through laser scanning and 63 coordinates were applied to each model using *Landmark Editor*. The resulting coordinate data were analysed using generalized Procrustes and principal components analysis (PCA). The 3D coordinates of the PCA were exported using *MorphoJ* so that a single 3D hamate model could be morphed into different positions of the PC shape space using *Landmark Editor*. This process generated interpolated 3D hamate models that facilitated the interactive visualization of the main shape differences that occur among these taxa. PC1 separates humans, great apes, and hylobatids because these genera show respectively narrower and longer hamates, more convex triquetral surfaces, and more distally projecting hamuli. PC2 distinguishes

gorillas because their hamuli are large relative to the hamate body and PC3 slightly separates orangutans because they exhibit more distally extending triquetral surfaces. Overall the first two axes reasonably segregate each of these taxa with the exception of *Pan* and *Pongo*, suggesting that it is possible to infer brachiation, below-branch suspension, and terrestriality in apes on the basis of the hamate, which is promising for future studies involving fossils.

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Comparing neutral markers, selective markers and human cranial morphology: are human skulls neutral?

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The microevolutionary processes involved in the evolution of the human skull are researched in many different ways. Recent studies compared the biological distances obtained for human skulls and microsatellites, attempting to test the correlation between them. Two of these studies found a positive and significant correlation between morphology and neutral molecular markers and concluded that the evolution of human skull as a whole followed stochastic events such as genetic drift and gene flow. Following this line of thought we compared the biological distances of genes known to be under positive selection with microsatellites and with craniometrics to investigate if the morphology still obeys a neutral pattern. To accomplish the test we used ten populations representative of Africa, Europe, Asia and Oceania that had molecular and craniometric data available for the same populations. We constructed distances matrices for all the variables and then calculated the correlation and significance between them. The results obtained were significant and positive between morphology and microsatellite ($r=0.7556$ $p=0.001$) between morphology and two selective genes (LARGE $r=0.6155$ $p=0.001$ and EDAR $r=0.3259$ $p=0.042$) and also between three selective genes and microsatellites (TYRP1 $r=0.0478$ $p=0.042$, SLC19A2 $r=0.3108$ $p=0.042$, LARGE $r=0.5720$ $p=0.003$). These results showed that it is possible to obtain positive correlations between features under selection and neutral molecular markers possibly because of the shared demographic history and that this correlation is not always synonymous of an exclusively neutral pattern of evolution.

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Craniometric variation of a comprehensive sample of early Americans: comparisons and initial observations.

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The peopling of the New World has been an area of intense anthropological research; however, tremendous debate still surrounds most related questions. This research hopes to address the levels of craniometric variation in a comprehensive sample ($n=145$) of early Americans that have been dated to 7000 yr BP or older. This is not an analysis solely based on "Paleoindian" samples (variably cited to date around 12,000 to 8500 years BP). The younger skeletal material was included for two reasons. First, this allowed the larger sample from Windover to be included and thus even out the samples from North and South America, where there are "larger" samples. Secondly, the cut-off in terms of date to be considered Paleoindian is somewhat confusing and dependent on author. Other studies have addressed the issue of early American cranial variation; however, most analyze samples from just one continent. Research that has attempted to utilize data from both continents is still heavily skewed toward one of the two continents. Statistical analyses conducted include principal component analysis and calculation of biological distances between individuals/samples. These preliminary data analyses indicate that there is considerable variation both between and within continents. There does appear to be a slight trend towards separation of North and South American samples through the principal component analysis. However, the biological distances are not significantly smaller for either continent, indicating that the patterns of variation between the continents may not be as different as suggested in previously published research.

The categorization of occupation in Identified Skeletal Collections: a source of bias?

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Identified skeletal collections, in which occupation at death is known, have been used to develop methods for recording enthesal changes (EC). The goal being to develop recording methods which are sensitive to different activity-levels which can then be applied to test hypotheses in archaeological contexts. However, defining the occupational categories used may be a source of bias. The aim was to test how categorizing occupation affected the interpretation of enthesal changes.

Male skeletons ($n=211$) from two Portuguese identified skeletal collections were used. Three methods for categorizing occupations all of which have been previously published were used each dividing occupations into 5, 3 and 2 categories, respectively. Fibrocartilaginous entheses were recorded and EC scored as present/absent.

Results showed that the method for categorizing occupation affected the frequencies of EC found in occupational categories by entheses. Frequencies which were significantly different between occupational categories for one method were not necessarily significant for others. This demonstrates that the sensitivity of the occupational categorization does affect the

results. However, using logistic regression age was found to have a greater effect. These results demonstrate the need for standardized occupational categories, as well as the importance of considering age.

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The worldwide phylogeography for a haplotype block in human Xp22.2.

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We reasoned that if a region of low recombination could be identified in the human X-chromosome, we could construct its genealogies in an analogous way to those based on haploid genomes, with the advantage of providing information about both male and female evolutionary histories. The genetic diversity and linkage-disequilibrium (LD) patterns in three South Amerindian populations were compared to published databanks including worldwide extant populations and archaic humans (HapMap3 and UCSC Genome Browser) revealing a worldwide haplotype block (haploblock) spanning ~15kb. Its diversity and distribution revealed that: (a) Africans showed the highest haplotype diversity; (b) private haplotypes were observed in Africa, India, and Mexico (a putative private Amerindian haplotype); (c) all continents shared the three most common haplotypes; (d) other species of the genus *Homo* showed the most common extant haplotype (suggesting it is 300 thousand years old); and (e) interpopulation genetic diversity supports the use of this haploblock as an Ancestry Informative Marker. Our results suggest a scenario of a recent African origin with a population bottleneck during the out-of-Africa migration and no admixture with archaic humans for this region, and support the use of this haploblock in phylogeographical and structural studies.

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Beyond treponematoses: differential diagnosis of the Garbacon Creek ossuary.

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In Recent years treponemal infection has been well documented in pre-Contact settlements of the American Southeast; however, studies concentrating on the evidence for Treponematoses may have not focused on signs of other conditions or overlooked other possible causes for the observed periosteal activity often taken as indicative of Treponemal infection. A selective account of pathology may also

misinterpret the interplay of multiple simultaneous health challenges which can result in different outward expressions of any or all conditions involved, and creates a different disease experience for the affected individual and the affected population.

The Late Woodland Garbacon Creek ossuary remains from the North Carolina coastal plain represent at least 33 individuals, and many of the elements show pathological activity. Of the tibiae alone, 65% present with periosteal lesions. The presence of at least one stellate lesion confirms the existence of treponemal infection in this population, but there are undoubtedly other diseases and conditions operating simultaneously. In this study, a differential diagnosis of the remains focusing on lesion morphology and frequency was conducted in order to provide a more complete view of the disease load in the Garbacon Creek population, which includes possible, scurvy, rickets, and iron-deficiency anemia. Along with considering a variety of other possible conditions, this study discusses the interactions between these conditions which may be complicating the diagnosis, and the social and economic burden posed by this chronic disease load.

Identifying victims of colonial violence: a historic case study from Northern Mexico.

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San Francisco de Borja is a mortuary cave site in Chihuahua, Mexico excavated by Richard and Sheila Brooks in the 1950s. Dating to the historic period, the individuals interred at this site are likely ancestral to the contemporary Tarahumara culture. A reanalysis of these remains was undertaken in order to more fully investigate initial findings suggesting perimortem violence. In addition to using standard osteological techniques to obtain data on individual identity, the remains were thoroughly analyzed for cut marks, fracture patterns and other signs of perimortem violence. Historical and ethnographic data on the Tarahumara and other groups nearby were also examined. This included information on Spanish colonial interactions with the Tarahumara and other cultures in the surrounding area.

Analyses indicate that a minimum of 11 adults and 7 subadults were interred at this site. Evidence for perimortem chop marks was found on one adult male individual aged 50 years or older. The chop marks on this individual are located on the left femur, left os coxa, and right tibia. The morphology of these marks suggests that they may have been made by a metal weapon. Additionally, perimortem neck fractures were discovered on at least two individuals. The wounds on these three individuals are consistent with ethnohistoric descriptions of Spanish colonial violence against the Tarahumara during this time period. Due to the combination of bioarchaeological, archaeological, and ethnohistoric evidence it is suggested that at least some of the individuals at this site were victims of Spanish political violence.

Phylogeography of the Sulawesi macaques based on 3D geometric morphometrics.

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The number of Sulawesi macaque species recognized by different authorities varies from one to seven. Previous studies have looked at hybrid zones, ecological variation, coloration, and behavior; to determine the number of possible species. This study uses landmark-based geometric morphometrics and various multivariate analyses to examine this question.

Forty-five three-dimensional landmarks were recorded using a Microscribe 3D-X on 229 macaque specimens representing 17 total species, including 5 Sulawesi (sub)species of known localities from a range of museums. Generalized Procrustes analysis (GPA) was used to superimpose the landmark configurations and scale them to the same size. Principle components analysis (PCA), regression analysis, and Procrustes distances were used to compare shape differences within and among (sub)species and to assess the amount of variance associated with different factors. Each analysis was performed on the total sample, as well as on separate analyses for each sex.

Allometry accounted for the largest amount of cranial shape variation (45%), with differences among taxa being the next most important factor (19%). Variation among the Sulawesi species was not different from that among the non-Sulawesi species, consistent with species-level distinction. However, Sulawesi samples were most similar to geographic neighbors. Sulawesi males also showed this pattern while among the females, three species showed this pattern and two were closest to non-Sulawesi species. This overall pattern is more consistent with a pattern of allopatric subspecies. Greater samples and more research is necessary, but our data complement previous genetic studies and patterns of soft tissue morphology in regards to this question.

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Bone area as a histomorphometric variable for evaluating age-related changes.

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Quantifying the amount of cortical bone loss is one variable used in histological methods of age estimation. The current cortical area measurement technique is subjective and disregards cancellous bone, which provides additional information regarding bone loss. This research determines if measuring bone area (cancellous + cortical area) rather than just cortical area improves histological age estimation at the sixth rib site. Specifically, this

research examines applicability of the bone area variable to a large sample of known-age skeletons and determines whether bone area is a less subjective, more repeatable measurement.

Mid-shaft rib cross-sections (Spitalfields N=233, St. Thomas' Church N=55) with a balanced sex distribution were used. Ages range from 17-92 years. Variables include: total cross-sectional area, cortical area (Ct.Ar), bone area (B.Ar), relative bone area (B.Ar/Tt.Ar), relative cortical area (Ct.Ar/Tt.Ar), and endosteal area.

A negative correlation exists between B.Ar and age. B.Ar/Tt.Ar and Ct.Ar/Tt.Ar display highly significant negative correlations in older years. Correlation strength is slightly higher between age and B.Ar/Tt.Ar. ANOVA results indicate significant relationships among age and B.Ar/Tt.Ar, and age and Ct.Ar/Tt.Ar. The relationship between age and B.Ar/Tt.Ar is consistently stronger than age against B.Ar and Ct.Ar variables. An intraobserver error test confirms reliability of measurements. Individuals greater than 45 years have significantly smaller mean bone areas than those below 45 years. Sexually dimorphic differences among variables were negligible.

Bone area assessment has the potential to improve accuracy of histological methods for the sixth rib. Including relative ratios, specifically B.Ar/Tt.Ar, will provide more relevant measures of bone area.

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Hypocones and pseudohypocones in Eocene primates: a microCT scanning approach to an old problem.

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Paleontologists have long argued about homologies between the disto-lingual cusp on the upper molars of Eocene primates. European adapines were described as having a "true" hypocone, derived from the disto-lingual cingulum, while North American notharctines were said to possess a "pseudohypocone", derived from the post-protocone crest or *Nannopithecus*-fold. Little research has been done on differences in the development of these cuspal morphologies among living or fossil primates. We used microtomography and three dimensional reconstruction to determine if clues to the development of hypocones and pseudohypocones might be revealed by an examination of the enamel dentine junction (EDJ). Since the original shape of the tooth crown is often not well preserved in fossils, the EDJ can yield important information about the original shape of the tooth crown, the presence of cusps, and early stages of tooth development. We scanned 6 adapines and 12 notharctines and were able to image the EDJ in 9 specimens (2 adapines and 7 notharctines). Our results suggest that hypocones and pseudohypocones are morphologically and developmentally distinct features. But they also document the presence of a dentine horn under the disto-lingual cusp of

notharctines, which suggests that there is nothing "pseudoe" about this cusp. In the broader context of mammalian dental development, Eocene primates provide another example of the convergent addition of a disto-lingual cusp to the primitive triangular upper molar. This evolutionary event has occurred upwards of 20 times among mammals, and has been linked to subsequent taxic diversification in many of these clades.

Population recovery and genetic variability in an urban environment: Singapore's banded leaf monkey population.

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The banded leaf monkey (*Presbytis femoralis femoralis*) is critically endangered in Singapore and threatened by widespread deforestation in southern Peninsular Malaysia. The Singapore population has recovered from as low as 20 to more than 40 individuals, but it was unclear whether the past bottleneck severely depleted the genetic diversity of the population. Here we assess the genetic variability based on seven samples (ca. 18% of population). We find two haplotypes that differ only in one variable site for the hypervariable region I (HV-I) of the mitochondrial *d-loop*. Compared to population-level data for other colobines (proboscis monkey, Yunnan snub-nosed monkey, Sichuan snub-nosed monkey, and Angolan black and white colobus), the banded leaf monkey population in Singapore has the most similar and the lowest number of haplotypes. This low genetic variability is a serious concern for the conservation of this population. Protected habitats in a prospering urban environment may become important sanctuaries for the recovery of endangered populations. However, past bottlenecks may require reintroductions in order to restore genetic diversity.

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The origin of Amerindians and the peopling of the Americas according to HLA genes: admixture with Asian and Pacific people.

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The classical three-waves theory of American peopling through Beringia was based on a mixed anthropological and linguistic methodology. The use of mtDNA, Y chromosome and other DNA markers offers different results according to the different markers and methodologies chosen by different

authors. At present, the peopling of Americas remains uncertain, regarding: time of population, number of peopling waves and place of peopling entrance among other related issues.

We have gathered most available HLA data already obtained about First Native American populations, which raise doubts about the classical three waves of American peopling hypothesis. Conclusions are: 1) North West Canadian Athabaskans had gene flow with: a) close neighboring populations, b) Amerindians, c) Pacific Islanders including East Australians and d) Siberians; 2) Beringia was probably not the only entrance of people to America: Pacific Ocean boat trips may have contributed to the HLA genetic American profile (or the opposite could also be true); 3) Amerindians show very few "particular alleles", almost all are shared with other Amerindians, Athabaskans and Pacific Islanders, including East Australians and Siberians; 4) Our results do not support the three waves model of American peopling, but another model where the people entrance is not only Beringia, but also Pacific Coast. Reverse migration (America to Asia) is not discarded and different movements of people in either direction in different times are supported by the Athabaskan population admixture with Asian-Pacific population and with Amerindians. Finally, gene genealogies should be completed with allele frequency analyses in population genetics.

Social networks and cooperation in Hadza hunter-gatherers.

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Social networks exhibit striking structural regularities, and recent theoretical and empirical evidence suggests that they may have played a role in the development of large-scale cooperation in humans. Here, we characterize the social networks of the Hadza, an evolutionarily relevant population of hunter-gatherers. We show that Hadza networks exhibit important properties also seen in modernized networks, including a skewed degree distribution, degree assortativity, transitivity, reciprocity, geographic decay, and homophily. Moreover, we show that Hadza camps exhibit high between-group and low within-group variation in public goods game donations. Network ties are also more likely between people who give the same amount, and this similarity in cooperative behaviour extends up to two degrees of separation. Finally, social distance appears to be just as important as genetic relatedness and physical proximity in explaining assortativity in cooperation. Our results suggest that social network structure may have been present at an early point in human history; that early humans may have formed ties with both kin and non-kin based, in part, on their tendency to cooperate; and that social networks may have contributed to the emergence of cooperation.

3D geometric morphometric analysis of the proximal epiphysis of the humerus of hominoids: functional interpretation, locomotor evolution and variability.

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All extant hominoids display an orthograde bodyplan, presumably mosaic-like acquired. This acquisition caused substantial modifications on the axial and appendicular skeleton. The forelimbs of orthograde primates present certain adaptive morphologies that enhance the mobility and excursion of the joints, especially at the glenohumeral region.

In this study, we present a three-dimensional geometric morphometric analysis of the proximal humeral morphology in extant great apes and humans, in order to accurately describe and measure the functional and anatomical differences between these taxa at the proximal humeral region. Moreover, a fossil hominin, *Australopithecus afarensis* (AL 288-1), is included into the analysis to test the potential of this approach to construct locomotor inferences based on fossil material.

Our analysis confirms that there are significant and quantifiable differences in proximal humeral morphology among the taxa, which has thus far largely remained unnoticed. Based on morphofunctional considerations, these anatomical differences can be correlated to differences in the locomotor repertoires of the several taxa, confirming that the proximal humerus is suitable for constructing paleobiological inferences on locomotion. Modern humans display markedly diverging features, which set them apart from both extant great apes and the fossil hominin. The proximal humeral morphology of the latter rather resembles that of orangutans, suggesting that, despite its adaptations to habitual bipedalism, the forelimb of this taxon was still functionally involved in forelimb-related arboreal behaviors. Our results for *A. afarensis* support that bipedal hominins evolved from arboreal ancestors instead of a knuckle-walking ancestor, which was possibly acquired independently by chimpanzees and gorillas.

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Spina bifida in a pre-Columbian Cuban population.

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Neural tube defects are common types of birth defects that involve the malformation of the central nervous system. Spina bifida, characterized by the midline separation of vertebrae, is one of these congenital neural tube defects; it is a complex, multi-factorial disease ranging in severity, from asymptomatic to severe clinical presentations.

Based on macroscopic paleopathological evidence in preserved sacra, it was previously uncovered that the disease was present in high proportions in a pre-Columbian Cuban population from the archaeological site of Canimar Abajo, Matanzas. Molecular paleopathological techniques were employed to examine this population's disease incidence in closer detail, examining 62 individuals (3000 to 1400 BP) for five single nucleotide polymorphisms known to be associated with spina bifida. It is postulated that the combined effect of these various polymorphisms, as well as environmental factors, determines the degree to which an individual suffers from spina bifida, if at all.

In this presentation, we demonstrate how multiplex PCR can be applied to archaeological samples. More specifically, the distribution of these polymorphisms in the sample population, and their correlation with the macroscopic evidence of spina bifida in specific individuals, is examined. Molecular evidence indicates there were potentially a much larger number of individuals carrying the single nucleotide polymorphisms than those who were macroscopically observed to suffer from spina bifida, though it is unknown whether these carriers suffered from the disease themselves. Consequently, this study elucidates how molecular techniques, particularly multiplex PCR, represent an important and successful means of examining genetic disease in past populations.

A digital radiographic and macroscopic study of scurvy and treponematoses in Algonkian juvenile remains from the ossuaries of the northern coastal plain of North Carolina.

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This study examines juvenile health from 8 ossuaries; 31CK9 (Baum Site) Burial 1 (split into 2 groups, UNCW, ECU and then together), 31CK9 Burial 4, 31CK9 Burial 5, 31CK9 Burial 7, 31CK22 (West Site) Burial 2, 31CO5 (Hollowell), 31ON309 (Jarrett's Point), and 31DR38 (Hatteras Village). Sometime in the 1990's the Baum Site had been separated into different repositories leaving approximately 150 pathological juvenile bones at University of North Carolina Wilmington and the Office of the State Archaeologist with the main collection being curated at East Carolina University. These bones have not been studied in any research prior to 1989. The ossuaries were located on the northern coastal plain of North Carolina, radiocarbon dated to the Late Woodland Period (800 A.D. – European Contact). They were affiliated with the Algonkian linguistic group. To aid in the diagnosis of scurvy and treponematoses digital radiographs were taken of

the most abundant and interesting lesions. It is hypothesized that the Algonkian children of the coastal plain were primarily healthy but did suffer from periods of nutritional and environmental stress. Data showed a surprisingly high prevalence of scurvy. Baum Burial 4, an infant < six months of age had scurvy, most identifiable on the sphenoid and tibia. This suggests congenital scurvy. It is also hypothesized that the juvenile populations suffered from a form of pre-contact treponematoses. The data suggest that Columbus and the Europeans did not bring treponemal disease to the Americas, nor did the indigenous populations introduce them to Europeans.

Ape-like mobility in the semi-terrestrially adapted foot of *Kenyapithecus africanus*.

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Two sexually dimorphic partial feet of the middle Miocene hominoid *Kenyapithecus africanus* from Maboko Island, Kenya are described. Both have MT IV and MT V, but the larger individual (body mass 54 kg) has a cuboid, and the smaller (21 kg) a navicular.

The *K. africanus* foot exhibits many derived ape-like features relative to *Proconsul* and *Hylobatids*. The cuboid is similar to *Homo* and *Pongo* in being wedged with a proximodistally shorter lateral than medial side. Such wedging is even more exaggerated in *Pan* and *Gorilla*. It also has a long calcaneal process similar to *Pan* and *Pongo*. As in African apes, the navicular is slightly abbreviated proximodistally, with a tuberosity that extends further distally than the articular surfaces for the cuneiform facets. Its lateral facet for the ectocuneiform lies in a plane that is oblique to the mesocuneiform and entocuneiform facets, as in great apes.

Non-hominoid features seen in the *K. africanus* foot include a large peroneal facet on the lateral side of the cuboid, an MT IV with a medioproximally oriented dorsal third metatarsal facet, and a laterally curved MT V shaft. In addition, the dorsoplantar diameter of the proximal articular surface of MT IV is larger than the mediolateral diameter, in contrast to the equidimensional morphology of African apes.

Functionally, slight midtarsal abbreviation and a large attachment for tibialis posterior indicate mechanical efficiency for midtarsal flexibility and inversion of the *K. africanus* foot, but the cuboid's large peroneal facet and metatarsal morphology are clear signatures of terrestriality.

Vegetation diversity and habitat heterogeneity: implications for chimpanzee feeding ecology across Kibale National Park, Uganda.

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Chimpanzees are found in habitats of varying quality throughout Africa. Within Uganda's Kibale National Park, the impact of human encroachment and deforestation varies, with restoration efforts in the south of the park (Mainaro), and natural succession occurring in the north (Kanyawara). The park's center (Ngogo) is less disturbed, and contains the largest chimpanzee community recorded.

We used nested vegetation plots to explore forest diversity and structure at the Kanyawara (N=52), Ngogo (N=52), and Mainaro (N=20) sites. Results indicate that Mainaro and Kanyawara have higher tree species diversity and evenness indices when compared to Ngogo. All sites share common trees such as *Diospyros abyssinica* and *Celtis durandii*, but important feeding tree density and distribution varies: Ngogo has the largest proportion of *Pterygota mildbraedii* trees, while Mainaro has a large number of *Uvariopsis congensis* trees. Comparison of size classes shows that Ngogo has larger trees overall, while Kanyawara has more trees between 30 and 80cm DBH. Proportions of medium and small-sized trees are similar between Mainaro and Ngogo, even though Mainaro has a large number of small trees that were planted as part of a restoration project.

Chimpanzee feeding trees represent a small fraction of the total forest system, but their succession patterns and pole/stem ratios provide important information on the current and future status of Kibale's habitat and on spatiotemporal dynamics of forest quality within Kibale. We will discuss the impact of human and other fauna (i.e., elephants) in relation to conservation and restoration efforts.

This work was supported by the Great Ape Trust of Iowa, the L.S.B. Leakey Foundation, the American Society of Primatologists, and Yale University.

Maternal mortality and morbidity in Miskito adolescents: biological and social vulnerability.

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Life history theory predicts that young women who begin to invest in reproduction while still allocating energy to their own growth and development may incur costs. Social and economic factors associated with adolescence also appear to increase risks for maternal morbidity and mortality. Population-based studies are needed to assess the biocultural effects of young maternal age on health outcomes. The data presented here focus on adolescents in Honduran Miskito communities and were collected during reproductive histories, health assessments, and maternal mortality surveys conducted in 2005 and 2009. Compared to women in their 20s, more adolescents reported experiencing morbidity during their most recent pregnancy; and during health assessments, anemia was most commonly identified in pregnant women under age 20. Adolescents also reported having less autonomy regarding health care decision-making than older women. In sixteen of the sixty maternal deaths reported, women were under age 20. More than half of these adolescents (n=9) were primiparous; and

the leading cause of death reported was hemorrhage (n=9), followed by prolonged/obstructed labor (n=4). Adolescents also died in route to a hospital/health center more often than older women. Results indicate that maternal morbidity and mortality risks are high for adolescents in this population. Physiological immaturity may partially explain their vulnerability, but a relatively low socioeconomic status also appears to play important roles by restricting participation in decision-making and delaying access to emergency obstetric care. Buffering young women from adverse outcomes therefore requires attention to both the biological and social forces that interact during reproductive events.

Support for this research was provided by the Wenner-Gren Foundation.

Long calls produced by male, Bornean orang-utans (*Pongo pygmaeus wurmbii*) advertise individual identity, context and an individual's future direction of travel.

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Flanged, male, Bornean orang-utans (*Pongo pygmaeus wurmbii*) produce long distance vocalisations or long calls that can be heard over a kilometre away. If a receiver can identify the caller and perhaps even obtain information about their dominance rank, then they can choose to approach or avoid the male depending on their own sex, quality and needs. Long calls are produced under a number of circumstances; if information about the caller is transmitted in the call then, perhaps, so is information relevant to the context. Anecdotal evidence also suggests the orang-utans call direction indicates their future direction of travel. In this study acoustic analysis of the long calls produced by the orang-utans at Sabangau, Central Kalimantan shows individual discrimination between the males and discrimination between the calls made under the different contexts wild orang-utans encounter. This study also demonstrates, for the first time, experimental evidence for orang-utans advertising their intended travel route by long calling and then continuing in the direction of the call. This behaviour suggests flanged, male orang-utans use their long call to spatially orient themselves and perhaps even to co-ordinate a network of loose associations.

The use of semilandmark methods to discriminate modern human crania by sex and ancestry: a pilot study.

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It has been established that ranges of human sexual dimorphism in adults differ among

populations. Various bony morphological regions in the skull and pelvis are used as standards for estimating within-population sexual dimorphism, but it is unclear to what extent ancestry contributes to among-population differences. Additionally, few studies have attempted to quantify the form of these morphological regions by which to discriminate human groups by sex and/or ancestry. This study utilized 3D geometric morphometrics methods to test whether 67 modern human adult crania from the William M. Bass Donated Collection at the University of Tennessee-Knoxville (including American Whites, Blacks, and Hispanics) could be reliably separated by sex and/or ancestry based on supraorbital/labelar morphology. Crania were laser-scanned using a NextEngine scanner, creating virtual 3D images. Since few homologous landmarks exist in the supraorbital/labelar region for use in analysis, cutting-edge semilandmark methods were used. 3D scan images were superimposed with 3 curves of semilandmarks anchored by standard landmark points (i.e., frontomale temporale, glabella, frontomale orbitale, nasion). These curves were treated as sets of homologous landmarks, whose 3D shapes were isolated and compared among groups using Canonical Variates Analysis. Results showed that semilandmark methods reliably separated crania into sex and/or ancestry categories at an accuracy level of $\geq 80\%$, suggesting that semilandmark methods are appropriate for discriminating among modern human groups. Future work will utilize semilandmark methods in multiple morphological regions of the skull to gain a more comprehensive understanding of modern human sexual dimorphism ranges and how they vary across geographic populations.

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You say adaptation, I say plasticity: defining secular change by examining morphological trends among archaeological groups.

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Anthropologists have focused regularly on changes in human morphology that occur over a course of one or a few generations. While a significant literature has developed in secular change research over the last century, only a few studies have incorporated morphological trends in archaeological groups. This may be due, in part, to limitations archaeological samples present in addressing short-term trends: cemeteries may consist of multiple populations, generational relationships are very rarely discernable, and potential causal factors cannot be isolated. However, in order to place more recent changes into context, patterns of morphological change over very long periods are necessary to better illuminate contributing factors. Factors from nutrition to disease to directional selection have been implicated in changes observed in stature, mass, limb length, and cranial shape.

Using metric data from over 4200 human skeletons dating throughout the Holocene, this study examines long-term trends in postcranial morphologies. Samples were grouped into

regions of varying scales, from broad regions (e.g., the Southwestern U.S.) to adjacent but temporally distinct sites. Stature, mass, limb lengths, and pelvic dimensions were examined along with climate and subsistence. Results reveal that general trends cannot be related between changes in morphology and environmental factors. For example, changes in body mass do not follow similar patterns among groups adopting new subsistence patterns, and other factors, such as gene flow, could not be excluded. Overall results caution against universalizing the relationships of specific factors with observed trends, and emphasize the importance of including archaeological data in studies of secular change.

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In the middle: sternal malformation at the Angel site.

ERICA L. AUSEL. Glenn A. Black Laboratory of Archaeology, Indiana University Bloomington.

It is acknowledged within bioarchaeology that the populational perspective is our greatest asset for understanding the greater picture of well-being and life and death in prehistoric populations. However, by not recognizing and discussing individual case studies we lose sight of our most grounded variable, the young person.

This study revolves around a social adult male from the Mississippian site of Angel Mounds, located in Evansville, IN. The pathological state of Burial 32 from subdivision X11B was discovered during a recreation project at the Glenn A. Black Laboratory of Archaeology and he was originally unearthed from a densely inhabited area of the site, the East Village, in September of 1940. Burial 32 exhibits extreme widening of the sternum, malplacement of articulating ribs, and elongated clavicles. In addition, a small degree of spina bifida occulta was discovered. Differential diagnoses include delayed caudal fusion of the embryological sternal bands and trauma.

Following the recent growth in social bioarchaeology, this presentation will not only discuss the biological genesis of this pathological state but will also explore how the condition may have affected this persons quality of life by exploring medical science literature. The purpose of this presentation is to open a discussion on the correlation between what we see in skeletal remains and the living state of the person.

A special thanks to the Glenn A. Black Laboratory of Archaeology, Indiana University Bloomington.

From bread to porridge: an analysis of dietary shifts during Roman rule at Karanis, Egypt.

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Karanis is situated along the northwestern edge of Egypt's Fayum region and was occupied during the transition from Ptolemaic to Roman rule. The Karanis Cemetery Survey Project conducted from 2008-2010 identified 7 different burial regions within the cemetery. A primary goal for the study was to determine changes in the diet of the Karanis population during this transition in order to enhance our understanding of the consequences of Roman rule on health and diet in Egypt. I hypothesize that the population at Karanis shifted from consuming primarily bread to porridge, represented by an increase in indications of softer diet in the mandibles and dentition collected and observed from the site's surface.

42 mandibles and 200 molars were observed during this study. Observations on the mandibles collected include body height, gonial angle, and maximum ramus height. Data on the molars were also recorded including wear stage, crown height, and crypt completeness. Additionally, abscesses, cavities, and calculus were noted as being either absent or present. T-tests ($\alpha=0.05$) were conducted to determine significant differences between the eastern and western burial regions.

Mandibles on the western portion of the site suggested a grittier diet with significantly smaller gonial angles ($p<.005$) and significantly higher maximum ramus heights ($p<.005$). Dentition similarly demonstrated grittier diets on the western portion of the site with significant loss in crown height ($p<.05$) and an increased wear stage ($p<.05$). Overall, these trends suggest a transition from bread to porridge as a staple of the diet during the Roman period.

Using pathology to explore cranial integration in *Homo sapiens*.

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Morphological covariation (integration) within and among major developmental regions of the skull (i.e., the cartilaginous neurocranium, membranous neurocranium, and membranous viscerocranium) has been demonstrated in modern humans. While most studies have focused on comparing covariation patterns among taxa or across ontogeny, we can also evaluate the strength of integration by comparing these patterns in healthy modern humans to those with pathologies that primarily affect a single cranial region. Two such pathological conditions are myxedematous endemic hypothyroidism (cretinism), where delayed endochondral ossification is expected to mainly influence the cartilaginous neurocranium, and microcephaly, where reduced brain growth will predominantly affect the membranous neurocranium.

For this analysis, ectocranial landmarks were assigned *a priori* to one of three developmental regions listed above. Three pairwise singular warps analyses were performed to explore covariation among these three regions based on healthy modern humans from 11 populations. Data from modern humans with cretinism and microcephaly were then projected onto the singular warps to evaluate the effect of their particular pathologies on the patterns of integration among regions. While the presence of pathological specimens increased the overall

variation present in the sample, in most cases the patterns of covariation among the cranial regions were retained even in the pathological groups. The one exception was a slight tendency toward a different pattern of integration between the cartilaginous neurocranium and viscerocranium in cretins. Overall, the results suggest that established patterns of covariation among the three major cranial regions remain relatively unaffected even in the presence of major developmental disruptions.

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Molecular assessment of dispersal in black-and-white ruffed lemurs (*Varecia variegata*).

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Dispersal is an aspect of an organism's biology that can influence fundamental processes of evolution, social behavior, and the long-term viability of populations. Male-biased dispersal and female philopatry are typical of mammals and most primates. However, exceptions are seen among fission-fusion primate societies (e.g., chimpanzees, spider monkeys), where males are often the more philopatric sex, and dispersal is generally female-biased. Despite weak behavioral evidence, ruffed lemurs are thought to differ from other fission-fusion primates, in that they appear to display male-biased dispersal similar to that seen in many other mammalian taxa. This hypothesis, however, remains largely untested.

We used genetic data to investigate dispersal, kin-clustering and intergroup relatedness in black-and-white ruffed lemurs (*Varecia variegata*). Biological samples collected from two behaviorally-distinct ruffed lemur communities in Ranomafana National Park, Madagascar were genotyped using a suite of 15 variable microsatellite loci. Results indicate that, unlike other fission-fusion primate societies, ruffed lemurs live in communities characterized by dispersal of both sexes, though it is likely that females disperse less frequently or at closer distances than do male conspecifics. On average, dyadic relatedness is close to zero, however communities are comprised of networks of both male and female kin. Relatives tend to live in close proximity and share higher degrees of home range overlap than unrelated neighbors, despite living within a communally defended range. Moreover, the mating system can be tentatively classified as polygynous and extra-community paternities are common. Thus, ruffed lemur communities can be said to represent behaviorally, but not genetically, distinct social units.

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Tooth size, sex differences, and health: an odontometric analysis of a modern Thai sample.

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The size of permanent teeth has been shown to aid in sex determination in some populations, and metric asymmetry of the dentition may provide information about differences in environmental factors that influence dental development. For this project, mesiodistal and buccolingual diameters were taken on modern Thai skeletons from the Chiang Mai University anatomical collection. Using binary logistic regression, these measurements were analyzed for sexual dimorphism in both their raw states and in crown indices (BL/MD). Lower canines proved to be the most dimorphic teeth, yielding formulae with up to 69.7% allocation accuracy. Accuracy improved to 78.4% when lower canine measurements were combined with upper 1st incisor and premolar measurements. These relatively low percentages limit the utility of dental metrics for sex estimation in this particular population unless combined with other corroborative methods. Asymmetry was also calculated in the sample using both directional and absolute asymmetry scores (DA and AA, respectively). T-tests revealed that none of the crown indices expressed directional asymmetry. All indices displayed statistically significant fluctuating asymmetry except for upper 1st molars. The presence of odontometric asymmetry implies that the average individual from the sample underwent developmental stress during childhood. Although this sample did not display great sexual dimorphism, the results from the lower canine in combination with those of the upper 1st incisor and premolar might prove useful in sexing young adolescents or other individuals for which morphological methods are inappropriate, particularly if used in combination with other traits.

The relationship between intensity of physical activity and musculoskeletal stress markers on the lower limb.

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This study focus on the effects of age, body size (as femoral length and femoral head superoinferior height) and intensity of physical activity on selected musculoskeletal markers (MSMs) of the femur. Skeletal collection representing 20th century Finns (Helsinki) with known age, sex and occupation was used in this study. Due to small number of female individuals analyses were performed using male data only. Based on the intensity of reported occupation the material was divided into heavy (N=17) and light (N=6) activity groups. Femoral entheses exhibiting most variation in the ruggedness scores were selected as activity indicators. These were the fibrous insertions of gluteus maximus and adductor brevis and the

fibrous origins of quadratus femoris, gastrocnemius and vastus lateralis. These obtained scores were recoded into binary variables. The effects of size and age on MSM were studied using ANOVA. As heavy and light labor groups were found to be similar in age and size, differences in MSMs between the activity groups were tested using Fisher's exact test. Left and right sides were analyzed separately. The intensity of physical activity was found not to reflect in the lower limb MSMs. Surprisingly also size did not affect the appearance of MSMs. Age affected only quadratus femoris and gluteus maximus MSMs. Similar results were obtained from left and right sides. These results indicate that neither labor nor size and age account for all the variance found in these studied MSMs. However, due to small sample size these results should be considered tentative.

This study was funded by the Finnish Cultural Foundation.

The origins of dental modernity.

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Research over the past decade has established that the study of dental morphological characters is a useful and important tool for interpreting the later stages of human evolution. A good deal of this research has focused on identifying dental characters that are relevant specifically to the distinction between Neandertals and *H. sapiens*, and more broadly to the question of modern human origins. However, while the dental patterns of certain recent *H. sapiens* populations have been described as primitive (e.g., Sub-Saharan Africans) or derived (Northeast Asians) relative to other groups, no study to date has proposed a dental pattern that characterizes *H. sapiens* as a species. To this end, this study investigates (1) whether or not there is a unique dental pattern in *H. sapiens*; (2) if so, which traits comprise this pattern; and (3) when, during the course of human evolution, these traits emerge. Our results show that size notwithstanding, *H. sapiens* has few uniquely derived dental traits that distinguish them from other hominins. These include the U-shaped fissure pattern of the lower P4, relatively flat, featureless upper incisors that are buccolingually narrow, lower molars lacking a hypoconulid and lower molars lacking any form of trigonid crest on enamel and dentine surfaces. Early *H. sapiens* from Qafzeh, Klasies River Mouth and Jebel Irhoud possess some of these characters. Interestingly, none of the recently discovered teeth from Qesem Cave, Israel exhibit any derived *H. sapiens* non-metric traits, while the molars of *H. floresiensis* are derived toward the *H. sapiens* condition.

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A comparative genomic investigation of the role for the NMDA receptor gene *GRIN3A* in synaptic plasticity.

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The evolution in humans of an extended juvenile period, altered patterns of brain glucose utilization, neuroplasticity, and increased longevity are associated with the emergence of encephalization, but how these coevolving features are related to one another remains unclear. In the present work we used a comparative genomics approach to examine one of these interrelated features – synaptic plasticity. In particular, we focused on *GRIN3A*, a gene implicated as playing a central role both in memory and synaptic plasticity. *GRIN3A* encodes a subunit of the NMDA receptor (NMDAR) family of glutamate-regulated ion channels. Using microarrays, we found that *GRIN3A* expression in the human cerebral cortex decreases with age. Moreover, this pattern differs from that seen in adult rodents, whose cortex does not express the gene. To study the evolution of *GRIN3A* gene regulation we examined multiple sequence alignments of its promoter in order to discover phylogenetically conserved and derived cis-regulatory elements in human, chimpanzee, gorilla, orangutan, macaque, baboon, marmoset, tarsier, and mouse lemur. Much of the *GRIN3A* promoter is conserved among primates, and conserved cis-elements include CREB and PAX binding sites. Moreover, conserved POU elements suggest a potential role for *GRIN3A* in dopaminergic neurons. The conservation of cis-elements in this gene suggests important functional constraints on the regulation of *GRIN3A* throughout primate evolution. Examination of the expression of *GRIN3A* in different species, developmental time periods, and cell types will enable us to discover whether primates also share similar constraints in terms of developmental expression patterns and cellular localization.

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Phylogeographic mitochondrial DNA genetic analysis of five Native American populations from lower Central America.

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The genetic history and biological relationships among Chibchan-speaking and neighboring populations were analyzed using mitochondrial DNA (mtDNA) haplogroup and haplotype diversity of 230 individuals from five (Rama, Maleku, Chorotega, Zapotón-Huetar, and Guaymí-Abrojo) indigenous populations from Costa Rica and Nicaragua. These populations were characterized by the major Native American haplogroups (A2, B2, C1, and D1). Inter and intra-population genetic methods were used to investigate the impact of stochastic evolutionary forces in these populations. The Zapotón-Huetar, Maleku, Guaymí-Abrojo and Chorotega contained high frequencies of haplogroup A2 (>60%) and smaller frequencies of haplogroup B2 and D1. The Rama showed high frequencies of haplogroup B2 (90%) and low frequencies of haplogroup A2. These results support observations of high frequencies of haplogroup A2 and moderate B2 among Central American Chibchan populations. Coalescent dates from haplogroup A2 show the divergence of Chibchan groups between 10,000 and 8,000 years before present (YBP). These results are consistent with the divergence of Chibchan languages in Lower Central America and a transition to agriculture. Phylogeographic examination, based on spatial analysis of molecular variance (SAMOVA) and genetic landscapes, demonstrated the existence of a genetic barrier for Central and Northern South American populations situated near Lake Nicaragua at around 8,000 YBP. These results are consistent with independent paleoecological studies. We conclude based on the mtDNA evidence for the endogenous development of Chibchan-speaking populations in Lower Central America.

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Development of sexually dimorphic traits beyond dental maturity in the cranium of *Gorilla gorilla*.

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Gorilla gorilla is one of the most sexually size dimorphic primates, where average adult male cranial size is approximately 22% larger than that of females. Though previous research has focused on sex differences in pattern of cranial growth in *Gorilla gorilla* through the course of ontogeny (i.e., until the point of dental maturity), little research to date has investigated the precise nature of how full cranial size is attained. The current study examines sex differences in size and shape changes of the facial skeleton and sagittal region of *Gorilla gorilla* beyond full M3 occlusion. Data were acquired using 3D surface scans and relative age was determined through assessment of molar wear. Results show statistically significant size increases beyond dental maturity in the midfacial region of both male and female crania, but patterns of shape change differ

between the sexes. Males and females also differ in their patterns of development of the sagittal region following dental maturity. Males vary in timing of development of a sagittal crest, with prominent sagittal crests most frequently observed in the oldest males. Changes to the sagittal region also occur through the course of female development and sagittal crests are observed in the later stages of adult female lifespan. The results are discussed in relation to socio-ecology, life history and biomechanical factors relating to mastication, and their implications considered in terms of their application to sex determination in extinct hominin samples (e.g., *Australopithecus* and *Paranthropus*), where high levels of cranial dimorphism have been inferred.

Lions and tigers and humans, oh my! Including human predation of primates in primate behavioral ecology.

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Predation is often invoked as a strong selection pressure on primate behavior and a key factor influencing primate group size. Previous reviews of primate anti-predator behaviors have included large group sizes, aggressive defense, alarm calling, and crypsis. However, human predation has largely been omitted from models and studies of primate anti-predator strategies. Consequently, little data are currently available on primate behavioral reactions to human predation. Nevertheless, primates are expected to employ anti-predator strategies that are predator-specific, and human predators are different in their use of projectile weapons, cursorial, and ambush hunting styles. Human predators preferably target larger primate species and have larger kill rates than nonhuman predators. Therefore, including human predation as a factor shaping primate behavior has consequences for group size optima and anti-predator behaviors. Given that many primate populations studied today experience some level of human predation, empirical tests of socioecological theory include populations under current or recent human predation pressure. I provide a revised socioecological model including the effects of nonhuman predation pressure on primate behavior. I predict that primates under human predation pressure have smaller group sizes and favor visual and auditory concealment. Studies of Diana monkeys, pig-tailed langurs, and colobus monkeys support these predictions. Rigorous methods for measuring human impact in primate study areas are necessary to determine the levels and types of predation risk that primates experience. Thus, human predation risk can be included in studies of primate behavior, resulting in improved tests of primate behavioral models and overall better model construction.

Sleeping site selection in the Bolivian gray titi monkey, *Callicebus donacophilus*.

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Our study examined sleeping site selection and associated behaviors of four groups, breeding pair plus offspring, of Bolivian gray titi monkeys, *Callicebus donacophilus*, in Parque Yvaga Guazu, Santa Cruz, Bolivia from March to May, 2011. Observers followed and recorded behavior of four habituated, free-ranging groups prior to sleeping and again the following morning. Tree characteristics such as height, DBH, canopy cover, vine density, and canopy connectedness were measured for each identified sleeping tree. Behaviors such as first and last activity, group sleeping order, and other social behaviors were recorded ad lib. The results indicate that groups prefer tall, emergent trees, averaging 18.7 meters that were fairly disconnected from the rest of the surrounding canopy. While sleeping, groups sat in contact with tails twined and offspring between the pair, possibly for protection from predators. Across all groups, feeding was the last activity displayed before sleeping 89% of the time and the first activity in the morning 84% of the time, suggesting the importance of food availability prior to and after sleeping. Groups tend to remain in the same tree for the duration of the night. One group, however, switched trees overnight 78% of the time. Further investigation is needed to determine if other factors such as resource availability, seasonality, and presence or absence of certain predators have an influence on sleeping site selection and sleeping behaviors.

Limbic structures in human evolution: new data and a meta-analysis.

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As a species, humans display elaborate social behaviors and extensive affiliative networks. Because emotion is increasingly recognized as central to social behavior and cognition, we asked whether structures implicated in emotion and motivation, i.e., "limbic" structures, are expanded in the human brain, despite historical assumptions to the contrary.

Our dataset combines new comparative data with data from the literature, addressing all limbic and limbic-associated structures with available volumetric data. These included the amygdala (and 4 amygdaloid nuclei), septum, striatum, thalamus, hippocampal formation, orbitofrontal cortex, and medial frontal cortex. As a contrast, we also assessed a non-limbic structure, the dorsal frontal cortex. We ran allometric regressions through independent contrasts of non-human primate data to assess whether human values were greater than predicted for a primate of our brain size, i.e., exhibited positive residuals. Where sample sizes permitted, we used student's t-tests to test the significance of human residuals.

Only residuals for the amygdala (and its lateral nucleus) and the orbitofrontal cortex were positive. The human residual for the medial frontal cortex was most negative, followed by

the hippocampal formation, the thalamus, striatum, and septum. The mean residual for the dorsal frontal cortex was negative, though it only approached significance. These data suggest that limbic structures participating both in emotional regulation and social affiliation, specifically the amygdala and orbitofrontal cortex, may have expanded in human evolution. Conversely, structures devoted to executive function and memory, like the dorsal frontal cortex and hippocampus, do not unequivocally distinguish human brains from those of other primates.

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Ecomorphology in a phylogenetic statistical context: a case study using the bovid femur.

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Antelopes (family Bovidae) are invaluable paleoecological indicators because many species have narrowly constrained habitat preferences. Ecomorphology is a method designed to predict function (e.g., habitat preference) from form (e.g., femoral measurements) without relying on taxonomic identifications. Ecomorphology is "taxonomy-free" in this limited sense, but it is not phylogeny-free. Researchers create predictive models using living species, which are interrelated in a phylogenetic hierarchy. Robust functional inferences can only be made using methods which account for this shared phylogenetic heritage.

This case study applies phylogenetic statistical methods to bovid ecomorphology. The published data set (Kappelman 1991. Journal of Human Evolution 20:95-129) consists of seven femoral metrics from 195 individuals belonging to 40 species. Two questions are addressed: (1) Are functional hypotheses regarding trait differences between habitat groups robust to phylogeny? (2) Do habitat classifications change when phylogeny is considered in Discriminant Function Analysis (DFA)?

Six of seven metrics differ significantly among habitat groups in a non-phylogenetic ANOVA framework ($p < .01$). In a phylogenetic framework (PGLS) four of seven metrics retain a significant difference. Proximal femoral characters have more phylogenetically robust functional signals than distal femoral characters. Non-phylogenetic DFA on species means resulted in a classification success of 75%. Phylogenetic DFA resulted in 67.5% classification success. This case study quantitatively demonstrates what has been suggested elsewhere; the anatomical differences between antelopes with different habitat preferences are phylogenetically structured. Thus, phylogeny is a potentially confounding variable that must be considered in ecomorphological studies. Methods for implementing phylogenetic ecomorphology are discussed.

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Multicultural governance of biocapital? Human genetic information, property, and contentious identities in Colombia.

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Since the 1980s, in Colombia, there has been a complex alignment of interests between some ethnic minorities' organizations and some environmental NGOs' agendas; this, at the same time that the national state took a multicultural turn in the 1991 Constitution. This conjuncture has enabled and shaped contested discourses defining what is biological diversity (including human diversity) and how access to it should be governed within indigenous territories—the great majority of them identified as biodiversity “hot spots”. The resulting social mobilizations ended up creating a legal labyrinth for biologists, geneticists, and physical anthropologists, in which their activities can be recognized as illegal within ethnic territories, and drawing concern on the circulation of second hand tissue samples stored locally and abroad. In this paper I present an ethnographic account about how multiple actors think about organic tissues and genetic information as capital—biodiversity as cosmology—and how they search for trade-offs in the name of autonomy and sovereignty, and the “right” to produce scientific innovation.

Growth and development of the hominoid shoulder girdle: can ontogeny tell us about locomotor ancestry?

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Hominoid primates share a number shoulder morphologies associated with arms used for overhead movements. Considerable debate exists, however, over whether these features are a product of shared ancestry or parallel evolution. Humeral torsion (i.e., rotation of the humeral head on the shaft), has received particular attention within this debate because of its potential in diagnosing locomotion in fossil primates.

Developmental data has been suggested to be informative in perceiving homology and homoplasy in a paleoanthropological context, although opinions are still divided on the value of ontogenetic analyses.

We investigate whether within-species ontogenetic approaches are aligned with between-species comparative approaches in estimating shared derivation of humeral torsion in African apes. We investigate 1) ontogenetic growth patterns by applying Gompertz curves to within-species population-level data of humeral torsion, and we investigate 2) rates of change of humeral torsion across individual branches of a phylogeny of 25 primate species.

Both the within-species and the between-species analyses point towards humeral torsion being a shared-derived trait among African apes and humans: 1) the growth curves of African

apes and humans are almost identical in shape and parameters, indicating that humeral torsion arises through homologous developmental processes, which suggests that humeral torsion is a shared derived character ; 2) the macroevolutionary analysis indicates a substantial increase in humeral torsion in the ancestral branch of African apes similarly suggesting shared derivation of humeral torsion.

These results show that ontogenetic growth patterns provide valuable information when exploring issues of homology versus homoplasy in primate hard tissue anatomy.

Human diet and mortuary patterns in the southeastern San Francisco Bay area: stable isotope analysis of the Ryan Mound population (CA-ALA-329).

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We present isotopic data to explore the relationship between diet and mortuary patterns among 145 human burials interred at the Ryan Mound (CA-ALA-329), a large earthen mound located along the southeastern shoreline of San Francisco Bay. Radiocarbon dating and artifact seriation place the burials within the Middle and Late Period (ca. 200 BC-AD 1770). Previous research in the Bay Area has revealed temporal and regional differences in paleodiets, indicating significant variation in the relative contribution of marine versus terrestrial resources. Early Period populations from the North Bay have significantly elevated $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values compared to other bayshore groups dating to the Middle and Late Period, suggesting a decline in marine resource consumption through time.

We conducted stable carbon and nitrogen isotope analysis of human bone collagen to track the sources of dietary protein (marine versus terrestrial), and stable carbon isotope analysis of bone apatite to evaluate contributions from all dietary macronutrients. $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values from the Ryan Mound are more depleted relative to foragers from the North Bay, but are more enriched compared to groups from the South Bay. Although proximity to bay resources explains some of the dietary variation, we also evaluate the relationship between diet and mortuary patterns (e.g., body position, flexure, orientation, burial associations, and location) to address potential differential access to resources within the population.

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An odontometric investigation of biological affinities of the Yashkuns of Northern Pakistan.

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The Yashkun are a Dardic-speaking ethnic group of northern Pakistan. Most researchers claim that Yashkun are immigrants from Central Asia (Cunningham 2010), but Dani (2001) asserts Yashkuns are indigenous to northern Pakistan and are descendants of the same population that yielded Burusho and Shina ethnic groups found in the same localities as the Yashkun. This research seeks to determine whether Yashkuns represent long-standing indigenous occupants of northern Pakistan or immigrants from Central Asia.

Yashkun origins are identified through a comparative analysis of permanent tooth size allocation among 163 Yashkun young adults from Astore, northern Pakistan. Maximum mesiodistal and buccolingual measurements were obtained for all permanent teeth except third molars in accordance with standardized methods. Individual measurements were scaled against the geometric mean to control for sex dimorphism and evolutionary tooth size reduction. These data were contrasted with 22 samples of prehistoric and living individuals from Pakistan, peninsular India, Central Asia, and the Iranian Plateau. Inter-sample differences in tooth size allocation were assessed with pairwise squared Euclidian distances and the patterning of phenetic affinities among samples was simplified with neighbor-joining cluster analysis and principal co-ordinates analysis.

Results indicate that Yashkuns possess close affinities to Burushos and Shins, with most distant affinities to other northern Pakistan groups. Yashkuns have no affinities to prehistoric inhabitants of Central Asia or the Indus Valley, or to living peninsular Indians. Hence, Dani's assertion that Yashkuns, Burushos, and Shins are all living descendants of a common, indigenous population of the Hindu Kush and Karakoram highlands appears confirmed.

Preliminary osteological analysis of human skeletal remains from El Cerro del Teúl Archaeological Project.

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El Cerro del Teúl Archaeological Project in Western Mexico focuses on a site that was continuously occupied for over 18 centuries (200 BC – 1500s AD). Archaeological excavations conducted under the auspices of Instituto Nacional de Antropología e Historia (INAH) have uncovered skeletal remains (MNI = 24) dating to several different eras within the 18 centuries of occupation. The first six skeletons excavated were fragile and fragmented, limiting data collection. This led to the development of a

protocol developed jointly by El Cerro del Teúl archaeologists and University of Massachusetts Amherst bioarchaeologists to take osteological measurements and photographs in situ. This poster will present preliminary analysis of the osteological data from El Cerro del Teúl Archaeological Project, including population demographics and cases of pathology and trauma. These findings will be discussed in relation to the archaeological context, which suggests distinct patterns of internment, and will highlight at least two cases of cultural modification—one individual features cranial deformation and dental mutilation and one individual features dental mutilation. In addition, we will discuss the feasibility of data collection from fragile, fragmented remains vs. the in situ measurements and photographs. Excavations at El Cerro del Teúl are ongoing, providing the opportunity to expand this data set.

This research represents the ongoing collaboration between the Osteology and Trauma Lab of the University of Massachusetts Amherst, directed by Ventura Pérez, and El Cerro del Teúl Archaeological Project, co-directed by archaeologists Peter Jiménez and Laura Solar from INAH's Office in Zacatecas.

Injury recidivism, trauma, and pathology in the multi-ethnic community at Grasshopper Pueblo (AD 1275-1400).

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Grasshopper Pueblo was a large, aggregated community in the American Southwest during the late 13th century into the 14th century. Initial settlement of the site occurred in AD 1275 and it reached its peak population (c. 700 individuals) approximately 50 years later. By AD 1400 the site was abandoned. Archaeological reconstructions suggest multi-group (multi-ethnic) cohabitation with a failure to blend together into a single unified identity. Isotopic data from non-local female burials in major room blocks indicate that intermarriage between different kin-based ethnic groups was an important part of community dynamics. Thus, while there is evidence of community growth and cohesion, there remains evidence supporting higher rates of inter-group conflict in the form of interpersonal violence and injury recidivism (individuals with an accumulated assortment of traumatic pathologies). Analysis of the human skeletal remains of 187 adults from the site included observation of lethal and non-lethal injuries as well as pathologies. Non-lethal trauma (healed cranial depression fractures and post-cranial trauma) was observed among all adult age groups and for both sexes. Young adults exhibit the highest frequencies of these injuries and females sustained larger and deeper wounds. Approximately one third (n=61) of the population had healed cranial depression fractures. Co-morbidity factors (i.e., injury recidivism) in a subgroup of young adult females fit the profile of captives. This study demonstrates the importance of looking at multiple indicators of trauma and stress for individuals as well as across the population.

This project was partially funded by the Graduate and Professional Student Association and the Rocchio Memorial Scholarship at the University of Nevada, Las Vegas.

The structural morphology of incisor and molar teeth: tracking the evolutionary pathways in Late Pleistocene humans.

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Reliable information for assessing evolutionary pathways, phylogenetic relationships, and adaptive strategies in extinct taxa and past populations is hidden within the dental tissues. Studies of enamel thickness (ET) and dental tissue proportions in Late Pleistocene humans have mainly focused on permanent molars. However, recent evidence from the Upper Paleolithic child Lagar Velho 1, Portugal, has shown that a contrasted signal could arise from the independent assessment of the molars and the incisors. Indeed, while the inner structural morphology of Lagar Velho 1's molars traces the extant human figures, its incisors bear a signature unreported in recent humans, closer to the Neandertal condition.

By using a high-resolution microCT record, we compared for ET topographic variation and dental tissue proportions the time-related structural evidence from incisor and molar deciduous and permanent teeth in a sample of European and Near Eastern Late Pleistocene humans, including Neandertals (n = 16) and anatomically modern individuals (n = 5). For each tooth, we virtually assessed the linear, surface and volumetric proportions of its crown components (notably, the enamel/dentine ratio). Our analysis also includes a microCT, radiographic and histological reference sample of worldwide extant human teeth.

While the patterns shown by the molars of the Middle and Upper Paleolithic anatomically modern humans represented in our sample globally fit the recent human condition and are distinguishable from the average Neandertal figures, results from the analysis of the incisors are more contrasted, the early Upper Paleolithic European specimens displaying a structural signature more closely approaching the typical Neandertal pattern.

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The diet of Bronze and Iron Age nomadic pastoralist populations from eastern Eurasia.

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This study investigates the relationship between the emergence of nomadic polities and the diet of pastoralist populations during the Late Bronze/Early Iron Age (1200-300 BC) and Xiongnu Period (500 BC-AD 155) of Mongolian prehistory. The Xiongnu were the first regionally based nomadic polity to emerge in what are modern day Mongolia and China. Due to the low productive yield of herding economies previous researchers have hypothesized that polities based on mobile pastoralism were reliant on sedentary populations to provide them with goods (e.g., silks, food items, or precious metals) used to promote their political and economic growth. The current research focuses on the effects agricultural products had on the foodways and dental health of archaeological populations from Mongolia, and uses dental texture analysis, macrowear patterns, and dental pathological conditions. These data were used to test if a significant difference occurred between the traditional diet of Late Bronze/Early Iron Age pastoralist populations (heavily reliant on dairy products and meat proteins) and the Xiongnu who supposedly integrated more Chinese agricultural goods (e.g., barley, millet, rice) into their diet. I hypothesize that a significant difference will not occur between the Late Bronze/Early Iron Age and Xiongnu period samples. Therefore, the Xiongnu's rise to power was a result of other attributes that were unrelated to their diet and foodways, and is evidenced by distinct similarities between the dental texture analysis results and low occurrence of dental pathological conditions related to the consumption of agricultural food products between the two populations.

The cochlear labyrinth of Krapina Neandertals.

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We present measurements of the cochlear labyrinth of Krapina Neandertals based on high-resolution computed tomography. The cochlea, a membranous, fluid-filled structure, houses the sensory end organ of the auditory system. Located within the inner ear, the cochlea occupies a spiral shaped cavity within the bony labyrinth of the petrous bone. The close anatomical relationship between the membranous cochlea and the bony cochlear labyrinth allows for the determination of cochlear size from fossil specimens. Recent studies with extant primate taxa suggest that cochlear labyrinth volume is functionally related to the range of audible frequencies. Specifically, cochlear volume is negatively correlated with both the high and low frequency limits of hearing so that the smaller the cochlea, the higher the range of audible frequencies. Our results show that the Krapina Neandertals have smaller cochlear volumes compared to modern *Homo sapiens*. Although the nature of the relationship between cochlear volume and hearing abilities remains speculative, the smaller

cochlear volume in Neandertals may reflect an upward shift in their audible frequency range.

Diet, dental health, and food acquisition in the prehistoric San Francisco Bay Area: bioarchaeology of the Ellis Landing Ohlone population.

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Bioarchaeological research often combines multiple lines of evidence in an effort to reconstruct the past lifeways. We evaluate the diet, health and food acquisition patterns of an Ohlone population through stable isotope and paleopathological analysis of individuals from the Ellis Landing site (CA-CCO-295), a late Holocene shellmound in the San Francisco Bay Area (ca. 3740 B.P. to 760 B.P.). Previous stable isotope research demonstrated that there was a high level of dietary variability in the population. The mean values for $\delta^{13}\text{C}$ of -14.3‰ and for $\delta^{15}\text{N}$ of 14.7‰ indicate consumption of marine resources with significant dietary contributions from C_3 ecosystems. The only significant difference found was between male and female $\delta^{15}\text{N}$ values ($z = 2.143$, $p = .032$). Although significant, this difference is small (males 0.5‰ higher than females) and may not be meaningful.

However, by including more comprehensive bioarchaeological data, a more complete picture of Ohlone prehistory can be interpreted. Previous research suggests that auditory exostoses are linked to the exploitation of marine resources in cold water. At Ellis Landing, males were the only individuals who exhibited auditory exostoses. If auditory exostoses have a behavioral etiology, then this suggests that males were the primary procurers of marine dietary resources, possibly explaining the difference in nitrogen values. Overall good dental health at the site supports the expectation that marine food consumption resulted in low rates of dental caries and alveolar abscesses in the populations.

Was juvenile scurvy endemic to Butrint, Albania during the Middle Ages?

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Scurvy (vitamin C deficiency) has recently received substantial attention in the paleopathological literature. A growing body of research suggests that the disease may have been widespread in southeastern Europe during the Late Roman and Medieval periods. We contribute to this evidence the methodology and results of a macroscopic assessment of porotic lesions in a sample of subadult skeletons (N=67) from Butrint, Albania. Lesions consistent with scurvy were observed in 31% (21/67) of juveniles from both rural and urban contexts in the vicinity of Butrint. Affected individuals date to Late Antiquity and the Medieval Period, suggesting that scurvy was a health problem in the region throughout the Middle Ages. Because

lesions caused by scurvy may appear grossly similar to and occur at skeletal sites often affected by lesions potentially indicative of other pathologies, great care should be taken when diagnosing the condition. Our approach places a heavy emphasis on the overall pattern of skeletal involvement. A diagnosis of scurvy was suggested only when an individual exhibited abnormal porosity at multiple skeletal sites commonly reported in the paleopathological and clinical literature. The juvenile remains from Butrint are significant because of the extraordinarily high prevalence of scurvy and, consequently, for providing many examples of the skeletal distribution of scorbutic lesions. In addition, we are able to identify morphological features that may aid in distinguishing scorbutic lesions from those having other possible etiologies.

Maternal marks of admixture in Cape Coloreds of South Africa.

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Previous studies of genetic diversity have suggested that the Cape Coloreds of South Africa are a highly admixed population with genetic roots from indigenous African groups including Khoisans, and the later arrival of Bantu speaking Xhosa farmers. Further genetic contributions came during European colonization of South Africa, which added to the inclusion of largely male European markers to the gene pool. Slaves from Indonesia, Malaysia, Madagascar and India are also thought to have contributed to the genetic makeup of this ethnic group. This study examines the maternal contribution of each of these groups to the genetic diversity of the Cape Coloreds through sequencing of the hypervariable region I of the mitochondrial DNA and through restriction fragment length polymorphism.

A total of 123 individuals were examined for this study. High frequencies of haplogroups L1 and L2 were found at 81.3 percent in this group (100 of the 123 individuals), which indicates that this group has a large African contribution to its mitochondrial makeup. Restrictions of the major European haplogroups identified nine individuals, 7.3 percent of the sample, belonged to haplogroups I and J. Five individuals (4.1 percent of the sample) belonged to the superhaplogroup M, indicating that Asian slaves did contribute to the maternal gene pool. The majority of maternal lineages in this Cape Colored sample are African in origin, with some European influence and a small contribution from Asian maternal lineages.

Comparison of age and sex-related changes in trabecular and cortical histomorphometry in a Roman archaeological population.

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Skeletal data from the Imperial Roman population of Velia demonstrates that cortical and trabecular bone remodel in different ways throughout the life course. Two methods were used in this analysis of bone fragility at Velia: analysis of vertebral trabecular architecture (n=63), and rib cortical histomorphometry (n=52), using three age cohorts (18-29; 30-49; 50+ yrs). The pattern of bone loss differs in important ways between both methods. The trabecular architecture results show that bone volume declines only slightly with age, with the trabeculae unexpectedly compensating similarly between sexes. In contrast, results for cortical histomorphometry reveal more pronounced gradual age-related change. Sex-related differences were explored for each method and no sex differences were observed in any age group. However, the timing of bone loss differed between the methods, with cortical bone showing the greatest loss from young to middle age, while trabecular bone dropped the most from middle to old age. The biosocial contexts of Roman daily life are explored to explain these results, with particular attention to diet, physical activity and reproductive history. Studies using a single method may fail to capture the complex processes of bone loss throughout the entire skeleton. Future studies should aim to include both trabecular and cortical bone in investigations of bone loss in past populations.

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Co-occurrence patterns suggest that interspecific competition shapes communities of primates, birds, bats, and squirrels in Borneo.

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A central issue in community ecology is assessing the role of deterministic processes, such as niche differentiation, in structuring communities. In this study, we investigate to what extent multiple community assembly hypotheses consistent with competition causing niche differentiation are supported. We focus on vertebrate communities on the island of Borneo, where we predict that patterns consistent with interspecific competition structuring communities will be more apparent when non-primate competitors of primates are included. Because primate communities are frequently viewed as self-contained research concerning the factors that determine their structure is most often limited to the primate community in isolation. However, if competition for food resources is more severe between primates and

non-primates than among primates, then the effects of niche differentiation on community structure may be masked if primates are studied in isolation; any signal of competition may appear weaker due to the exclusion of non-primate competitors. We therefore test the implicit assumption from previous research in primate ecology by examining whether primates in Borneo compete predominantly with other primates or with other vertebrates, particularly birds, bats and squirrels. Specifically, we test for checkerboard distributions, guild proportionality, Fox's assembly rule for favored states and nestedness. We found strong support for patterns consistent with interspecific competition structuring communities, particularly when taxonomic groups were combined. These results demonstrate the presence of significant ecological structure and are consistent with the interpretation that competitive interactions within and between these taxonomic groups may have shaped the species composition in these communities.

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The Great Irish Famine: producing "lifeways" for victims and survivors using isotope ratios and elemental concentrations.

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During the Great Irish Famine (1845-1852) millions of rural Irish poor left their homes, arriving in Britain as a stepping stone to other destinations or settling in major towns and cities: 108,000 settled in London during this period. Reconstructed diets can be used to determine status and origin (Trickett 2007, Muldner et al. 2009). Based on documentary evidence which suggests differences in food consumption (Crawford and Clarkson 2003) and environmental exposure to heavy metals (Drummond and Wilbraham 1939), this research examines whether there is a difference in isotopes and elemental concentrations between indigenous Londoners, first generation Irish migrants in Lukin Street, and those they left behind in the Kilkenny Workhouse.

Using bone, tooth and hair from individuals from the Cemetery of the Catholic Mission of St Mary and St Michael, Whitechapel (1843-1854), and the Famine Cemetery at the Kilkenny Union Workhouse (1847-1851), analyses of isotope ratios and elemental concentrations have been carried out to compare the two populations and reconstruct "lifeways" for some individuals. Results show these analyses can be used to discriminate between Londoners, first generation Irish, and other migrants.

Analysis of carbon and nitrogen isotopes using dentine sections reveals dramatic changes in diet during the development of the teeth with high temporal resolution. These results challenge some of the accepted interpretations of skeletal and dental manifestations of diet and the link between changes in nitrogen isotope ratios and physiology.

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Amud 7, a Neandertal infant from Amud Cave, Israel.

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During the renewed excavation (1991-1992) at the Amud cave in the Galilee, in northern Israel, a partial skeleton of an infant was found. The skeleton, Amud 7, is that of a young Neandertal whose estimated age is 10 months and has been dated at about 45 thousand years. The base of the Amud 7 skull was published shortly after its discovery (Rak et al. 1994).

The aim of this study is to describe all the skeletal remains of Amud 7, to determine whether scattered remains assigned to other individuals might actually belong to Amud 7, and to compare the hitherto undescribed postcranial morphology of Amud 7 to that of other Neandertal and modern human infants.

We will discuss elements of the Amud 7 calvarium and mandible that have not yet been described; the clavicle, scapula, and humerus; and fragments representing the seven cervical vertebrae, eight thoracic vertebrae, three lumbar vertebrae, and the first to twelfth ribs. We will also present the remains of the ilium and tibia.

Our preliminary inspection reveals some Neandertal characteristics of the Amud 7 skeleton, such as a pitted suprainiac fossa; a square outline of the broad, chinless mandible; a highly curved clavicle; a narrow glenoid cavity with a large axilloglenoid angle; and a relatively straight first rib.

Beyond natural selection: exploring the role of non-adaptive reasoning in undergraduate students' evolutionary explanations.

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Non-adaptive evolutionary causes, such as genetic drift, comprise an important element of explanatory models of evolutionary change for biologists, physical anthropologists, geologists and paleontologists, and yet science education research has focused almost exclusively on student ideas and misconceptions about natural selection. After instruction that includes non-adaptive causal factors (e.g., genetic drift), how do students construct evolutionary explanations? We used clinical

interviews, open-response (ACORNS) and multiple-choice (CINS) instruments to investigate undergraduate students' non-adaptive reasoning patterns. Data generated from the interviews and instruments were analyzed for use of key concepts, non-adaptive reasoning and naïve conceptions.

After instruction, non-adaptive reasoning was found to be very uncommon in students' explanatory models of evolutionary change in both written assessments and clinical interviews. However, when non-adaptive reasoning was used by students, it was conceptualized in an expert-like way; that is, non-adaptive factors were modeled as alternatives to selection. Additionally, Pearson correlation analyses indicated that interview non-adaptive reasoning scores showed strong and significant associations with ACORNS non-adaptive reasoning scores ($r = 0.75$, $p < 0.01$), but higher non-adaptive reasoning scores were *not* significantly associated with greater key concept scores for the ACORNS ($r = 0.04$, n.s.) or higher CINS scores ($r = 0.08$, n.s.). Thus, non-adaptive reasoning appears to be a distinct facet of evolutionary thinking. Greater attention to non-adaptive reasoning in undergraduate science education is needed given how uncommonly students use it to explain evolutionary change and how necessary it is for students to gain an accurate mental model of evolutionary change.

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The face of *Afropithecus turkanensis* and the ancestral morphotype of the Catarrhini.

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Images of *Afropithecus* (KNM-WK 16999) are among the most iconic in paleoanthropology today, and the unusual morphology of this taxon has been highly influential in debates on the ancestral morphotypes of the Catarrhini and the Hominidae. However, recent comparisons of the type (KNM-WK 16999) with specimens of a second individual (KNM-WK 16992a,b,c) reveal a surprising pattern of differences that are likely due to distortion in the type. While fragmentary, KNM-WK 16992a,b,c include parts of the palate and the frontal bone with excellent preservation, unlike the type, in which many surfaces are represented by matrix alone. KNM-WK 16992a preserves portions of the alveolar processes of the maxilla and premaxilla. KNM-WK 16992b preserves portions of the superior orbital plate and supraorbital region. Together, these specimens lack the midfacial projection, premaxillary prognathism and vertically oriented frontal bone that give the type its distinctive profile. There is also no sign of a frontal sinus. In each case the corresponding parts on the type are damaged or represented only by matrix, with little or no surface bone preserved. Compressive distortion of a matrix filled cranium would also explain the highly unusual orbital morphology of the type. The morphology of KNM-WK 16999 is not a faithful representation of *Afropithecus*. This taxon did not share potential ancestral catarrhine features with *Aegyptopithecus* and *Victoriapithecus*. Instead, it more likely

resembled similarly-sized *Proconsul nyanzae* in many aspects of facial, but not dental, morphology.

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Patterns of interpersonal violence and warfare in the prehistoric San Francisco Bay Area, California.

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Osteological evidence from hunter-gatherer populations has revealed unambiguous evidence of interpersonal violence throughout the prehistoric record. Recent research has been directed toward understanding the patterns and social implications of violence and warfare among these groups. While evidence of interpersonal violence has been well-documented in populations from the Santa Barbara Channel area of southern California, much less is known about patterns of aggression among the prehistoric inhabitants of the San Francisco Bay Area. Previous research from the region reported relatively high levels of projectile point injuries, as well as moderately high levels of craniofacial trauma. In addition, a pattern of trophy-taking, including the removal of forearms, has been recently documented at a number of sites. The present study provides the first spatial and temporal synthesis of osteological indicators of interpersonal violence from prehistoric central California, and incorporates data from 30 archaeological sites, including new data on late Holocene populations from the San Francisco Bay Area (ca. 3000 BC-AD 1700). Through evaluation of craniofacial trauma, projectile point impacts, trophy taking, demographic patterns, archaeological context, and paleoenvironmental data, we provide a bioarchaeological synthesis of interpersonal violence patterns in the San Francisco Bay Area. Results indicate the highest frequencies of trauma in the Bay Area appear in the Early/Middle Transition and Middle Period, during a time of significant social change marking the incursion of populations from the Central Valley. This research provides a holistic understanding of the social implications of violence and warfare in prehistoric central California, drawing from osteological, archaeological, and ethnographic sources.

How to distinguish and analyse locomotor groups in the Hominoidea: analysis of supraspinous and infraspinous fossae with geometric morphometrics, 3D laser scanning and new methodologies to measure muscle mass.

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Extant hominoids share an orthograde corporal pattern, which allows the free movement of the glenohumeral joint, permitting the appearance of new forms of locomotion.

This study provides a quantitative analysis of the posterior side of the hominoid scapula, including modern humans. Our objective is to find patterns of variation in scapular shape through a multivariate analysis of morphological features in order to distinguish different types of locomotion observed in hominoids and thus to be able to better understand the locomotor patterns of fossil taxa. We apply 2D geometric morphometrics, 2D areas, 3D real areas, the classical *spinal fossae index*, and compare the results with muscular weights obtained from dissections of primate cadavers.

Our results suggest that knuckle-walking was independently acquired in *Pan* and *Gorilla*, and that the last common ancestor of humans and chimpanzees was mainly arboreal, with a shoulder morphology similar to that of orangutans. We conclude that the new methodologies applied are useful tools to study the morphology of the scapula and its muscles. The detailed analysis of the morphology of the posterior side of the scapula is particularly suitable to differentiate the types of locomotion observed in hominoids. Moreover, even if one should be careful about inferring conclusions based exclusively on the study of bones because a substantial part of the data about soft tissues is lost, by using our methodologies it is possible to estimate quite accurately whether a scapula (based only on the morphology of this bone) belongs or not to a particular locomotor group.

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Combining occlusal fingerprint analysis and computer-based methods for 3D digital reconstruction of Sts 52.

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The *Australopithecus africanus* specimen Sts52 includes a partial lower face (Sts52a) and a fragmented mandible (Sts52b). Various defects characterize both parts, so that any attempt to match upper and lower dentition fails. The left hemimandible completely lacks the ramus, part of the corpus, and shows several broken teeth,

whilst in the right hemimandible both the coronoid process and the angle are broken. In the left hemiface the maxilla and nasal bones are compressed laterally and shifted backward.

In this contribution we show how the preserved macrowear pattern of the tooth crowns can be used for the functional reconstruction of Sts52's dental arches, and how the restored dental positions provide fundamental information for the digital reconstruction of the whole mandible and the lower face.

High-resolution epoxy casts of the upper and lower dentition were used to extract information of individual antagonistic occlusal contacts. A detailed wear pattern mapping and its functional interpretation constrains the individual crown position and their antagonistic relationship. The reconstructed dental arches were 3D surface scanned, and registered on the 3D models of the original Sts52 specimens. The reconstructed lower dental arch was used to create a target template. Afterwards a reference mandible (*Pan troglodytes*) was warped onto the target template, restoring the Sts52b mandible. For the Sts52a reconstruction a non-rigid *Flow* transformation based on scattered data interpolation was performed.

The outcome of this reconstruction shows for the first time a complete functional reconstruction of *A. africanus* dental arches, thus providing new morphometric data for Sts52.

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Stable isotopes and socioeconomic differences among urban Colombian women: additional insights from ³⁴S.

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The stable isotope composition of mammalian tissues, such as hair, can indicate the composition and/or geospatial origin of the diet. Previously, we reported that $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values from hair track socioeconomic status (SES) differences among urban Colombian women, despite a lack of SES differences in long-term indicators of nutritional status (including body mass index, five body circumference measures, and six skinfold measures). Here, we present $\delta^{34}\text{S}$ values and additional results from the same sample of 38 women from lower SES (n=19) and higher SES (n=19) groups. There is no significant difference in mean $\delta^{34}\text{S}$ values between the lower SES ($5.1 \pm 1.1\text{‰}$) and higher SES ($4.6 \pm 0.4\text{‰}$) groups, unlike the previously reported $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values. However, the $\delta^{34}\text{S}$, $\delta^{13}\text{C}$, and $\delta^{15}\text{N}$ values are all significantly more variable within the lower SES group (Levene's test, $p < 0.05$ in each case). There is a significant negative, but weak, correlation between $\delta^{34}\text{S}$ values and $\delta^{15}\text{N}$ values ($r^2 = 0.11$, $p < 0.05$), but no significant correlation

between $\delta^{34}\text{S}$ values and $\delta^{13}\text{C}$ values or any of the 12 anthropometric measures. Hence, $\delta^{34}\text{S}$ values reveal an additional axis of variability within this sample distinct from SES differences, anthropometric measures, and $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values. The higher variability in $\delta^{34}\text{S}$, $\delta^{13}\text{C}$, and $\delta^{15}\text{N}$ values within the lower SES group could reflect higher variability in the isotopic composition or geospatial origin of the diet. Alternatively, the observed differences could reflect variation in the isotopic spacing between diet and tissues resulting from differing dietary quality or nutritional status.

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Patterns of dental eruption and growth in a wild population of Guinea baboons (*Papio h. papio*) in the Department of Kedougou, Senegal.

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Little is known about the growth and development of *Papio h. papio* in the wild. Data relevant to addressing this deficiency (dental casts, photographs, and somatic measurements) were collected during the trapping of 267 Guinea baboons in the Department of Kedougou, southeastern Senegal, as part of a long-term study of sylvatic, mosquito-borne viruses. Relative ages of the baboons were assessed through a combination of dental eruption and tooth-wear patterns. All age groups occurred in the sample, indicating they represent a reasonable cross-section of the population.

The dental eruption sequence for Guinea baboons was found to differ somewhat from both yellow and olive baboons, as upper I2 emerges only after lower I2 is completely erupted. In male Guinea baboons, upper P3 erupts after both M2s are fully erupted, but in yellow and olive baboons both P3s erupt isochronally with M2. Male Guinea baboons are more similar to yellow than to olive baboons in having upper canines erupt after lower P3, and lower M3 before upper M3.

Plots of body weight and other measurements against age demonstrate female progenesis, with females ceasing their growth at about age five and males continuing to grow until about age eight, similar to other baboons. At age eight, body weight sexual dimorphism is high, with males (n=15) averaging 19.05 kg and females (n=13) averaging 10.92 kg. Measurements for all body proportions were found to be less in the oldest members of the sample, possibly tracking local climate history (severe drought) experienced during their developmental years.

Genetics and identity: ethnogenesis in a Jamaican Maroon community.

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In this study, the biological relationship between an ethnic minority, Accompong Maroons, and majority Jamaican population are accessed using genetic data. Accompong Maroons reside within St. Elizabeth parish in western Jamaica. They are the descendants of the island's indigenous population, known as Taíno and escaped enslaved Africans. Due to their physical location in the hinterlands of the island and a series of wars with the British, the Maroons developed into an isolated semi-autonomous community on the outskirts of colonial society. This isolation seeded the beginnings of a subpopulation with distinct linguistic and cultural traits, and land inheritance patterns that differed from the larger population. With the abolition of slavery in 1834, isolation became less of a factor and inter-marriage between Maroons and other Jamaicans occurred. According to 19th century ethnohistorians, Maroons appeared both culturally and phenotypically different than the general Jamaican population. These distinctions, however, were not visible to later researchers. In spite of such assertions, Maroon identity remains strong within the community reinforced by annual rituals and access to untaxed land.

To address the question of Maroon distinctiveness, the CODIS panel was genotyped in a sample of 53 Accompong residents and compared to other Caribbean populations. Summary statistics and multidimensional scaling plots based on genetic distances indicate that the Accompong Maroons are not distinct from other Caribbean populations. Though further studies are needed to corroborate these findings, this study contributes to the general body of knowledge regarding the process of ethnogenesis as it occurred in the Americas.

This project was funded with an Annual Pilot Grant for Social Science Research supported by the Institute of Scholarship and Learning, College of Arts and Letters at the University of Notre Dame. Additional support was received from the Undergraduate Research Opportunity Program and the Balfour Heshburgh Scholars Program in conjunction with the Center for Undergraduate Scholarly Engagement, also at the University of Notre Dame.

An examination of micronutrient content of selected Tana River Primate National Reserve, Kenya, yellow baboon (*Papio cynocephalus*) foods.

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As part of our investigation of yellow baboon nutrition, we examined mineral content of common food sources – an area little studied in primate nutritional ecology. Consumption and

nutrient content data for the Mchelelo troop (n=75) are based upon January 1988-October 1992 observational data (875 days; 4893 hourly scans) and chemical assays of 110 samples representing 56 flora species (31 families). We assayed calcium, phosphorous, potassium, magnesium, iron, zinc, and manganese content for each sample using AA or UV spectrometry. Tana baboon foods averaged (dry matter basis): calcium=0.335% (SD=0.31); phosphorous=0.233% (SD=0.10); potassium=1.532% (SD=0.53); magnesium=0.215% (SD=0.14); iron=0.034% (SD=0.05); zinc=0.002% (SD=0.001); manganese=0.011% (SD=0.06). The data were transformed using the following formula to determine dietary mineral concentration: mineral concentration (mg/kg) = sum over all species of [(Average mg/kg mineral for a given species * % of observations for that species)/100]. Tana baboons' dietary mineral concentrations exceed NRC recommendations for iron, manganese, magnesium, and potassium; but are below recommendations for calcium, phosphorous, and zinc. The top three foods' contributed more to dietary minerals than would be expected from the relative consumption of these foods ($X^2=53.475$, $df=6$, $p<0.001$), and the top 10 foods account for up to 95% (e.g., manganese) of some of the dietary minerals. A few species are responsible for large proportions of particular minerals (*Salvadora persica*: iron, *Dobera glabra*: manganese, *Hyphaene compressa*: zinc.) Our data indicate that a limited number of species ingested by Tana baboons account for most dietary minerals. Mineral content may be a factor in primate food choice.

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Warm-climate foragers have less famine than other societies.

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Some have questioned using hunter-gatherers to guide our thinking about our early human ancestors because hunter-gatherers occupy marginal habitats. This is often assumed to be the result of more powerful agricultural societies defeating them in warfare and thus pacifying them. If ethnographic foragers do occupy marginal habitats we might assume they would experience more famine. Despite the impression that foragers occupy marginal habitats and are therefore subject to more hardship than other, more powerful societies, the foragers described in the Standard Cross-Cultural Sample (SCCS) experience less famine. One study (Benyshek and Watson 2006) found that foragers do not have more famine than agriculturalists. Here, we show that once we limit the analysis to warm-climate societies (Effective Temperature $\geq 13^\circ\text{C}$), then foragers actually have less famine ($U = 522.0$, $p = .001$, $n1 = 14$, $n2 = 114$) and less recurrence of famine ($U = 226.0$, $p = .013$, $n1 = 9$, $n2 = 85$) than societies in the other three modes (pastoralists, horticulturalists, and intensive agriculturalists).

Stable isotope data for monkeys of the Ivory Coast's Tai Forest.

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The seven cercopithecoid species of the Ivory Coast's Tai Forest provide opportunities to explore ecological diversity among sympatric monkeys. Taxon-specific ranging, feeding and morphological data are available for all species; however, stable isotope ratio analysis has not yet been attempted for this primate community. Here, we present data from modern rib bone for seven monkey species: *Colobus polykomos* (N=7), *Cercocebus atys* (N=6), *Procolobus verus* (N=4), *Procolobus badius* (N=7), *Cercopithecus diana* (N=6), *Cercopithecus campbelli* (N=3), and *Cercopithecus pataurista* (N=1). Stable isotopes of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) from bone collagen and stable isotopes of carbon ($\delta^{13}\text{C}$) and oxygen ($\delta^{18}\text{O}$) from bone apatite are analyzed.

All samples produced excellent bone collagen and apatite yields and isotopic results are consistent with the closed canopy habits of this community. The data, however, indicate some discrimination among taxa. For example, Kruskal-Wallis tests demonstrate significant variation for $\delta^{15}\text{N}$ and $\delta^{18}\text{O}$ values among species, inferred to correlate with diet and microhabitat, respectively (e.g., ground foraging in *Cercocebus* and arboreal feeding in *Procolobus*). Posthoc pairwise tests reflect the observed, non-overlapping $\delta^{18}\text{O}$ values as a predictor of ground vs. arboreal feeding regimes. ANOVA tests exploring differences by sex and age (adult vs. non-adult) for pooled taxa demonstrate $\delta^{13}\text{C}$ values for bone apatite are significant by sex and $\Delta^{13}\text{C}$ spacing values (apatite-collagen) are significant by age, suggesting differences in dietary quality and/or dietary fractionation of preferred foods. Isotopic data from these modern primates underscore the potential to model and perhaps test dietary variability of sympatric primates in the past.

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A test of cross-species exome sequencing in the rhesus macaque (*Macaca mulatta*).

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The advent of high-throughput, second generation sequencing methods promises new insights into primate evolution and adaptation. In primates, links between genotypes and phenotypes have been explored with the "candidate gene approach," in which a locus with a phenotypic connection in a well-known organism is sequenced in other taxa. However, candidate gene insights do not always transfer between species, and this method has often found no sequence variation in new species that

can reliably be associated with phenotypic variation. Collection of the full protein-coding genome (the exome) is an emerging alternative to candidate gene sequencing. In this study, we sequence the exome of a rhesus macaque (*Macaca mulatta*) using a targeted sequence enrichment protocol designed for the human genome. The availability of the sequenced macaque genome allows us to quantify how well the cross-species approach works in terms of accuracy, bias, and efficiency and evenness. Additionally, by mapping the reads to the annotated regions of the published macaque genome, we assess non-synonymous SNPs found in the exome for potential functional or disease connections. Since macaques, whose ancestors diverged from those of humans roughly 25 million years ago, are no more distant from humans than any other catarrhine primate, the success of our pilot study should be similar when applied in any other Old World monkey. The technique piloted in this study has the potential to extend the benefits of second-generation sequencing to primate taxa that lack a published genome.

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Investigating load-carrying in non-human primates: the case study of infant-carrying in Olive baboons.

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What was the impact of load-carrying at the time of the evolutionary transition to habitual bipedalism? This is a usual palaeoanthropological questioning to which comparative experimental data for non-human locomotor models would help answering; though, nearly none is available. We collected kinematics of loaded and unloaded quadrupedal walking in a group of 60 Olive Baboons at the Primatological Station (CNRS, France). During 5 months of motion capture, 11 females were nursing their infant and regularly walked loaded and unloaded (infants: new born to 1 year old) on the walkway of experiment. Motion captures were performed thanks to the high speed and high definition video recording system (200fps) available at the motion analysis technical platform we setup on the site. Individual inertial properties were calculated using external anatomical measurements. Here, we compared loaded and unloaded spatiotemporal parameters and joint angles for a sample of 30 cycles of walking performed by 4 females. No significant difference between loaded and unloaded parameters was observed. As far as joint angles are concerned, individual variation increases when the female carries the infant; this could reflect varied strategies of carrying. We are improving the experiment with a larger sample of cycles of walking, integrating kinetics and kinematics of several carrying strategies and the mass of infants at different stages of individual development.

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Papio facial growth and ontogenetic morphological variation.

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This study investigates post-natal growth of the maxillary and sub-nasal regions of *Papio anubis*, and seeks to identify patterns of bone growth remodeling that underlie morphological variation in the craniofacial skeleton among adults. Surface features reflecting bone cell formation and resorption activities were identified using reflected light and scanning electron microscopy to assess bone growth remodeling patterns. The sample utilized is that of well-documented individuals of known chronological age from the Southwest Primate National Research Center collection from the Washington University in St. Louis, Missouri.

The analysis revealed several interesting results, which have implications for understanding craniofacial sexual dimorphism in *Papio anubis*. Geometric morphometric analysis indicated that both sexes shared a common size/shape growth trajectory with late divergence beginning around four years of age. Investigation of bone remodeling activity demonstrated large depositional areas near the canine alveoli, maxillary tuberosity, and the premaxilla of both sexes during early ontogeny. These depositional areas were then replaced by bone resorption in the subnasal and zygomatic regions as individuals aged from four to approximately six years of age, corresponding with sexual maturity in females.

Despite differences in adult morphology between the sexes, results indicate that the spatial patterning and timing of bone formation and resorptive processes in the maxillary and subnasal regions of the face are similar during ontogeny. Future analyses aimed towards understanding differences in bone remodeling activity rates at these sites may provide further insight into the mechanisms underlying the evolution of sex differences in the adult craniofacial morphology of anubis baboons.

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Detecting modular components on the human skull: implications for the structuring of global human cranial variation.

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In the last decades several studies have shown that morphological integration and modularity are important points of intersection between evolution and the development of organisms. These studies are particularly abundant on debate about the nature of the morphological integration and modularity of skull. However, few of these studies have showed how this hierarchical nature can explain the worldwide variation observed among human skulls. In this study we explore the pattern of correlation and covariation of cranial morphology of 17 populations dispersed along six great geographic regions of the world to investigate if the human cranial observed variation can be described in terms of modular differentiation and if it could be considered a relative predictor to the acquaintance of the global structuring. To achieve our goal we constructed correlations and covariances matrices over 47 craniometric variables of 981 individuals from classical Howell's databank, divided in two different hierarchical levels: populational and regional (continental). An extra meta-population containing all individuals of the sample was used as control. The modules were detected by comparison of these matrices. The results obtained by our investigation show that the populations studied presents strong modular similarity within great regions and some markedly modular differentiations and disproportions between these great regions. In despite of the small sampling and the technical deficiencies of our methodology, our results suggests that the human cranial variation should be evolved partly rather by means of selective pressures than stochastic processes and also should have responded differently to these pressures.

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Cranial morphology of early human skeletal remains from Lapa do Santo, Lagoa Santa, Brazil: implications for the settlement of the New World.

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Lapa do Santo is a rock shelter located in Lagoa Santa (central Brazil) where 28 human burials have been excavated since 2001. A subset of 13 burials is of early Holocene age, with six individuals directly dated to between ca. 9,000 and 8,200 BP. The other burials are from different chronological periods, varying to between ca. 5,000 and 7,700 BP. In this study we compared the cranial morphology of eight (five from the older chronological set) best preserved adult skulls recovered from Lapa do Santo with two other early South American paleoamerican series: Sumidouro (n=13), also from Lagoa Santa, and Sabana de Bogota (n=57), from Colombia. The worldwide human cranial variation, represented by 18 populations from

Howell's databank (n=1,684) was also included in the study. The morphological affinities among the series were explored through two different multivariate statistical techniques: Principal Components Analysis and Mahalanobis Distances. Both males and females were used in the analyses and the data was previously treated by means of double standardization to correct for sexual dimorphism and size. Our results show a strong association between Lapa do Santo and the other two South American paleoamerican series represented in the study. Within a worldwide perspective Lapa do Santo shows a clear association with Africans and Australo-Melanesians instead of with Asians and late Amerindians. These results support the idea that the New World was settled by two independent Asian colonizing biological stocks along time.

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How do wild gibbons decide where to sleep?

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Where animals choose to sleep depends on a variety of behavioral and ecological factors. Despite sufficient quantitative data on factors defining sleeping site choices, predation avoidance is often regarded superior over food access, avoiding parasites, comfort, and range/resource defense. With a comparative approach, we tested all hypotheses for the selection of sleeping sites in four wild white-handed gibbon groups (*Hylobates lar*) at Khao Yai National Park, Thailand. From July-November 2010, we recorded 59 sleeping trees for ten adult individuals. The food access hypothesis was supported by a significantly shorter travel distance between the last important feeding tree and the sleeping tree compared to the average distance traveled between important feeding trees visited that day, defined retrospectively as trees in which the gibbons fed longer than the average duration in other important feeding trees. Likewise, they fed significantly longer in the last important source compared to other important sources of that day. The predation avoidance hypothesis was supported by the selection of concealed sleeping locations within trees and cryptic behavior prior to retiring. Defecation never occurred at a sleeping tree, and individuals were at significantly lower heights during defecations than while engaged in other activity perhaps to avoid parasite contamination. We conclude that the selection of sleeping sites in white-handed gibbons is multi-functional. Individuals choose sleeping trees strategically to primarily maximize access to important food trees and avoid predators while factors like comfort and parasite avoidance may also influence where gibbons spend the night.

Variation in sexual dimorphism of postcranial robusticity and body proportions in European Holocene populations.

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It has been shown that substantial changes in human societies have an impact on sexual dimorphism during the Holocene mainly as a consequence of changes in gender-specific subsistence activities and craft specialization, as well as access to resources. Over 2000 individuals across Europe from eight periods are analyzed for sexual dimorphism in stature, body mass, and cross-sectional properties of femora and tibiae. Mean percentage of sexual dimorphism indicates that dimorphism in stature increases from the Mesolithic (4.9%) to the present (7.8%). Dimorphism in body mass increases from the Mesolithic (13.2%) to the Neolithic (22.5%), followed by slight decrease in Modern sample (18.8%). Dimorphism in cortical area is lower in femora (range from 5.7 to 8.7%) compared to tibiae (range from 12.3 to 15.5%), but no clear tendency is observed. Dimorphism of femora Ix/Iy increases from the Mesolithic (6.2%) to the Neolithic (11.1%) and declines to the Modern period (1.7%). Sexual differences of tibial Ix/Iy decrease markedly from the Mesolithic (12.1%) to the Neolithic (1.8%) followed by a fluctuation in later periods. Dimorphism in femoral robusticity (Zp) fluctuates from 7.2% to 12.2% but does not indicate any tendency. Tibial dimorphism in robusticity increases from the Mesolithic (11.9%) to the Bronze Age (22.8%) followed by a decrease to the Modern sample (12.8%). In conclusion, results indicate that subsistence, social, and economic changes throughout the Holocene have an impact on sexual dimorphism in femoral mobility index and tibial robusticity, as well as body size.

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Parametric model of a bunodont molar.

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In an effort to understand how occlusal tooth morphology relates to diet, researchers have studied tooth relief and the radius of curvature of cusps. Parametric models of teeth

have been built and engineering concepts used to optimize tooth designs; those morphologies have been sought in nature. Idealized morphologies do not correlate with diet with a high level of consistency, perhaps because in nature structural strength in the tooth overrides idealized morphology.

Here we present a parameterized finite element (FE) model to simulate the contact mechanics of a bunodont molar interacting with a large hard food item. Parameters assigned to this model include radius of curvature of all four cusps in both buccolingual and mesiodistal directions. For this study, the radii of curvature were varied and FE analysis simulations were run. We applied a force of 2 kN to the molar, which was made to bite into a large, hemispherical substitute food item which consistently had a radius of curvature significantly greater than the radii of curvature of the cusps.

We predicted that radii of curvature would be positively correlated with the tensile stresses in the tooth and negatively correlated with the tensile stresses in the food item. This was true for stresses in the tooth but not the food item. This is because as the radii of curvature in the cusps decreased, the contact area between the tooth and food item increased due to the shape of the valley between the cusps.

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From popular culture to scientific inquiry: a bioarchaeological analysis of vampires in post-medieval Poland.

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Mythical beings, such as vampires, have undoubtedly become a mainstay in popular culture. However, these fictitious evildoers have a very real counterpart in many cultures throughout the world. In post-medieval Poland, for example, vampires were synonymous with evil spirits bent on spreading disease and wreaking havoc for the living society. Not all deceased people were at risk of becoming vampires; however, for those that society deemed to be such a threat, specific anti-vampiristic methods were employed to prevent vampirism. These methods, as evidenced in the mortuary context, have been found in several burials from a 17th-18th century cemetery in Drawsko, Poland. The purpose of this study is to compare the health of the "vampire" burials to those of the rest of the cemetery sample. Since determinations of who may become a vampire were often culturally determined, we anticipate little or no health differences within the sample. Health indicators, including stress markers (e.g., linear enamel hypoplasias), dietary deficiency (e.g., scurvy), infection (e.g., periostitis, tuberculosis), and trauma (e.g., intentional injuries), were assessed from 34 adult skeletal remains (males n=14, females n=20), including three vampires (males n=1, females n=2). Results (chi-square, p<0.05) indicate that there

are no significant differences in the health of those interred with anti-vampiristic measures from the rest of the sample, at least as they are measured by these indicators. These results corroborate the assertion based on historical and cultural information that vampires were primarily culturally defined in this population and not necessarily biologically determined.

Urinary C-peptide indicates male chimpanzees do not experience significant energetic stress at Ngogo, Kibale National Park, Uganda.

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Recent studies of non-human primates have demonstrated urinary C-peptide is a valuable biomarker of energetic condition. C-peptide tracks seasonal variation in food availability and is sensitive enough for intra- and inter-individual comparisons. Validation of C-peptide allows quantification of the costs of dominance, reproductive effort, reproductive state, and immune challenges in a way that was not previously possible. In this study, we applied this method to 40 adult and adolescent male chimpanzees at Ngogo, Kibale National Park, Uganda. This site is of special interest because Ngogo chimpanzees, compared to their neighbors at Kanyawara, enjoy higher daily and monthly net caloric gains. This is most likely due to occupying a habitat that is less variable in fruit production and more abundant in high quality food sources. We analyzed 420 samples for urinary C-peptide with corresponding phenology data, and over 1,000 hours of behavioral data. Food availability varied seasonally during this two year study period. However, contrary to predictions and in contrast to findings at Kanyawara, average C-peptide levels did not vary significantly by food availability. These results suggest that Ngogo male behavioral modifications are sufficient to avoid reductions in energetic condition during periods of lower food availability. Other primates reduce energy expenditure by reducing travel time or increasing resting time in these contexts, but this does not seem to be the case at Ngogo. Instead, we suggest that males cope by decreasing party size during relatively lean times. This research highlights the importance of exploring habitat variation in behavioral ecology.

This study was funded by the L.S.B. Leakey Foundation, the International Primatological Society, the American Society of Primatologists, Explorers Club, and the Yale Center for Human and Primate Reproductive Ecology.

Regional specializations in the chimpanzee neocortex: pyramidal neurons are more branched and spiny in the prefrontal cortex.

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The cerebral cortex is characterized by a variety of neuron types, differing in morphology, chemical properties and patterns of connectivity. Studies examining the structure of the most common neuron type in the primate cerebral cortex—the pyramidal cell—have shown phylogenetic diversity and regional functional specializations. Specifically, in humans and macaques it has been demonstrated that, compared to sensory and motor areas, the prefrontal cortex, which subserves higher-order cognitive functions, is characterized by pyramidal neurons with the greatest degree of morphological complexity, thus suggesting enhanced power for cortical integration.

Although substantial research has been conducted on humans and macaque monkeys, little is known regarding regional differences in the structure of pyramidal neurons in the chimpanzee neocortex. To investigate whether chimpanzees display the same pattern of regional heterogeneity observed in humans and macaque monkeys, we used a rapid Golgi technique to compare pyramidal neuron morphology in prefrontal (area 10), primary somatosensory (area 3b), primary motor (area 4), and prestriate visual (area 18) areas in the left hemisphere of seven adult chimpanzees. We used NeuroLucida software to trace ten neurons from each region of interest in each individual (N=280). Results demonstrated that, consistently with studies on humans and macaques, pyramidal neurons of the prefrontal cortex (area 10) have a more complex structure, exhibiting significantly greater dendritic extent as well as greater spine number and density than the other cortical regions. These findings support the view that specialization of the prefrontal cortex region was important in the evolution of the primate brain.

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The 'hole' truth: collateral ligament fossae size and shape and hominoid locomotor adaptations.

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Locomotion and positional behaviour are among the most basic functional parameters defining primate species. Primates represent a greater diversity of locomotor adaptations than

any other mammalian order. In particular, hominoids encompass a number of distinct locomotor adaptations, each one associated with a unique hand posture, phalangeal orientation and characteristic pattern of mechanical loading (i.e., knucklewalking, fistwalking, hooked grasping hand postures associated with suspension, bipedalism). While it is widely accepted that phalangeal shaft curvature is an adaptive response to the habitual stresses of locomotion, relatively little is known about the relationship between collateral ligament fossae size and shape and locomotion. Radial (RCL) and Ulnar (UCL) collateral ligaments stabilize the MCP and IP joints and are comprised of an accessory ligament proper (dorsally located; taut in extension) and the accessory collateral ligament (volarly located; taut in flexion).

This study employs 3D shape analysis to test the hypothesis that collateral ligament fossae size and shape vary according to locomotor adaptation and hand posture. Collateral ligament fossae surface areas were obtained from five hominoid genera (n=49) with diverse locomotor adaptations, and comparisons of fossae area and shape were made between discrete locomotor groups. Results indicate that knuckle-walking apes have deeper and more restricted fossae with steeply sloped margins, while suspensory apes have shallow and broad fossae. Humans have the smallest and shallowest fossae. A more detailed understanding of the relationship between collateral ligament fossae morphology and locomotion will ultimately contribute to research questions addressing the evolution of hominoid locomotor adaptations.

Skeletal evidence for handedness throughout growth and development.

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By using bilateral asymmetry of the humerus as a proxy for handedness, it is possible to gain insight into the development of this trait during growth. A large skeletal sample of non-adults from several archaeological sites in England, was examined using traditional metric techniques to assess when right-sided asymmetry can be detected in the human skeleton. Results of this work indicate a change in directional asymmetry during growth and development, with infants and young children exhibiting no significant asymmetry and older children and adolescents demonstrating right-sidedness, which is similar to what has been observed behaviorally in living children. From a biomechanical perspective, what would be expected if there was no hand preference or if that preference continually shifted back and forth during infancy and early childhood. The degree of asymmetry in different features of the humerus was also found to exhibit variability. Genetic canalization can be used to explain this feature, with the current work supporting the conclusion that length and articular dimensions of the humerus are more strongly canalized than diaphyseal properties.

Reductions in helper T-cells and increases in natural killer cells are associated with poorer growth in an indigenous Amazonian population.

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The relative proportion of different lymphocyte subsets varies between populations, yet data relating this variation to broader life-history patterns is limited. We address this lack by testing for trade-offs between growth and lymphocyte subset counts in the Tsimane, a population of forager-horticulturalists with high infectious exposure. Using flow cytometry, we identified T-cells (CD4+, CD8+), B-cells (CD19+), NK-cells (CD56+), and naïve T-cells (CD45RA+) in 540 blood samples. We tested for trade-offs using change in age standardized height (Δ HR) from the previous year. Total lymphocyte count ($\beta = 1.46$ cm/1000 cells/yr (CKY), $p < 0.01$), CD4 count ($\beta = 6.86$ CKY, $p < 0.01$), and percent naïve CD4 cells ($\beta = 12.90$

cm/100%/yr, $p = 0.07$) were all associated with positive Δ HR, while NK-cell count ($\beta = -5.93$ CKY, $p = 0.07$) and CD8 cell count ($\beta = -6.01$ CKY, $p = 0.01$) were associated with negative changes in Δ HR. Overall Tsimane had lower CD4/CD8 ratios, CD4 counts, and naïve CD4 proportions, and higher NK-cell counts than most age-matched populations in North America, Europe, and Africa. These results suggest the Tsimane pathogenic environment may deplete CD4 cells and reduce available naïve cells, and increase production of NK-cells, and that these effects are related to poorer relative growth scores.

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Adaptability within boundaries: support use in two species of *Lepilemur*.

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We compare the locomotor behaviour of *Lepilemur edwardsi* within Ankarafantsika, with that of *Lepilemur ruficaudatus* in Kirindy-Mitea, Madagascar. Data from each species was collected by different individuals, ten years apart, but following exactly the same data collection protocol.

Locomotor mode frequencies were found to be closely comparable for both species: *L. ruficaudatus* leap 56%, vertical climbing 26%, other 17%; *L. edwardsi* leap 52%, vertical climbing 32%, other 16%. No significant differences were found in initial and terminal support orientation: both species having preference for vertical supports. However differences were observed in support diameter, whereby *L. edwardsi* used supports 5.1cm or larger more often than would be expected and *L. ruficaudatus* used supports 5cm and under more frequently than would be expected. Data further suggest that while support orientation is of high importance to these specialist leapers, they are able to adapt to available support diameters, suggesting that neither have strong preferences for support diameter, either for enhancing stability or to utilise support flexibility for takeoff or landing.

We propose rather that the differences between the two species are largely caused by habitat differences, specifically those brought about by the destructive effect of Hurricane Fanele in January 2009 on Kirindy-Mitea. Fanele was found to have damaged 95% of the trees, with 8.5% mortality. Trees with a larger diameter were found to be most likely killed or damaged. While individuals inherit their underlying biology they must adapt their expressed behaviour to the available environments, which are subject to change.

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Histomorphometric differences in tibial cortical bone based on sampling location.

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Presentation Withdrawn

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Histomorphometric analysis of cortical bone is often used to estimate age at death of skeletons or to make inferences about mobility in past populations. Although previous studies have indicated that remodeling is variable within a single cross-section of bone, there has been little examination of the nature of these differences in the human tibia. This study investigated whether there are differences in remodeling between the anterior and posterior cortices of human tibiae.

Slides of undecalcified sections of human tibiae at midshaft (N=10) were used to analyze histomorphometric properties including percent remodeled bone, osteon population density (OPD), average Haversian canal size, and average osteon size. These properties were analyzed separately for the anterior and posterior cortices of each section. Non-parametric statistics were used to test for differences between sampling sites and for age-related correlations.

Results indicate that there is a difference in remodeling of the cortical bone that is dependent on sampling location. Compared to the posterior cortex, the anterior cortex has a significantly greater percent of remodeled bone as well as a higher OPD. Although the difference is not as pronounced between sampling locations, it also appears that the anterior cortex generally has greater porosity with larger Haversian canals. No significant difference in average osteon size was found between anterior and posterior cortices. These results support the idea that remodeling can progress in contrasting ways between various areas of the same section of bone. Therefore, care should be taken when comparing histomorphometric properties from different areas of tibial cortical bone.

This study was funded by Stony Brook University.

Epidemiology of developmental dysplasia of the hip in Amerindians: cases from the Late Prehistoric Buffalo Site, West Virginia.

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Developmental dysplasia of the hip (DDH) refers to misalignment of the acetabulum and femoral head. DDH is a disease spectrum, ranging from dysplasia as the mildest form to subluxation to dislocation. There are few palaeopathological cases of DDH reported or attempts describing the full spectrum and prevalence of this condition from bioarchaeological contexts. The aim of this study is to describe a range of cases of DDH from an archaeological Amerindian population and discuss the epidemiology, pathophysiology, and risk factors. Clinical prevalence of DDH in modern Amerindians is 35-76 per 1000, the highest rate among modern populations. It is hypothesized that DDH prevalence in archaeological populations of Amerindians will be comparable to that of modern Amerindians.

The whole or hemi-pelves of 214 adults from the Late Prehistoric (1490 B.P. ± 70)

Buffalo site, West Virginia were examined for DDH. Diagnosis was made from observation of shallow, irregular, or obliterated true acetabulum, associated with formation of a false acetabulum on the posterosuperior aspect of the ilium. The morphology of true and false acetabula was classified and other changes of the pelvis, lower limb, and spine were noted along with cranial deformation.

A total of 7 adults (6 females, 1 male) from the series were identified as having DDH; 1 dysplasia, 1 subluxation, and 5 dislocations. The overall lifetime prevalence of DDH for this population is 3.27%, which is near the lower end for modern Amerindians. Though etiology is uncertain, biocultural factors for high prevalence in the Buffalo population are discussed.

Diet predicts milk composition in primates.

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Mammalian mothers pay heavy energetic costs to fuel the growth of their offspring. These costs are highest during lactation. Energy transmitted to offspring in the form of milk must ultimately come from the maternal diet, but there have been few comparative studies of the relationship between milk properties and mammalian diets. We used interspecific data on primate milk composition and wild diets to establish that concentrations of milk protein and sugar are predicted by diet independent of maternal mass, litter mass, and infant parking behavior such that increasing folivory or faunivory increases protein concentration but decreases sugar concentration. Milk energy density is unrelated to diet, though infant parking species do produce more energy-dense milk. While parking effects have been previously explained as a result of mother-infant separation, the mechanisms causing the relationship between nutrient packaging in milk and maternal diet are currently unclear. However, they likely reflect evolved differences in maternal energetics related to maternal foraging ecology, infant growth patterns, or the relative dietary abundance of nutrients costly to synthesize in milk among primate species.

Integrating the stable isotope and nutritional ecology of an East African forest.

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Stable isotopes are commonly used to reconstruct the diets and habitats of living and fossil animals. We sampled plants from Kanyawara, Kibale National Park, Uganda to investigate the stable isotope ecology of an East African tropical forest which is home to 13 primate taxa. We measured stable carbon and nitrogen isotopes, as well as protein, fiber, total non-structural carbohydrates, and lipids in 266 samples of 36 species. Leaf carbon isotope values reflected the well-known canopy effect, an isotopic depletion in the forest subcanopy due to decreased light and photosynthetic use of soil respired carbon dioxide. While leaves separated isotopically by canopy layer, this pattern was not evident within the crowns of individual trees. Stable nitrogen isotope values exhibited the opposite pattern, with midstory leaves exhibiting the most enriched values and canopy, emergent, and gap/edge leaves respectively more depleted. Intra-specific differences in carbon isotope values were detected between mature and young leaves among five tree species. A weak negative relationship was found between carbon isotope values and leaf cellulose content ($r^2 = 0.2559$, $p < 0.005$), as well as between carbon isotope values and a fiber (hemicellulose+cellulose) to protein ratio ($r^2 = 0.3438$, $p < 0.0005$), which may represent an index of leaf toughness. Isotopic variability is thus associated with the nutritional composition and structural characteristics of forest foliage, which are significant for primate leaf selection. While causal relationships are uncertain, these data highlight the need to consider multiple correlates of isotopic variability within tropical ecosystems.

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The positioning of the lunate sulcus in *Pan troglodytes*: a statistical analysis.

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Previous research indicates variability in the positioning of the lunate sulcus, the boundary of the primary visual cortex, in *Pan troglodytes* (Holloway et al. 2003). However, the statistical significance of this variation has not yet been established. The purpose of this research is to test whether or not the position of the lunate sulcus can be predicted in chimpanzees as suggested by Holloway (1985; 1997). Variability in the location of this landmark has been used as evidence to support the hypothesis that differences in brain organization precede brain enlargement. If the position of the lunate sulcus is variable, yet predictable, this data can be expanded and used as the basis for future hypotheses. Endocasts of fossil hominins can be examined to see if the position of the lunate sulcus varies significantly from the position in chimpanzees, and therefore if it varies from the presumed position in the last common ancestor.

The variations in the position of the lunate sulcus between individuals, the hemispheres of the brain, and the sexes were taken through three cord measurements. These

measurements were standardized using hemispheric weight and overall brain weight. The standard deviations for these values are low and the three measurements are strongly correlated ($p < 0.0005$). There is no significant variation between hemispheres ($p > 0.1$) or between the sexes ($p > 0.1$) with regard to the position of the lunate sulcus. This data indicates that the position of the lunate sulcus can be accurately estimated.

Estimating turnover in fossil hominins from the Omo-Turkana Basin, Ethiopia, and Kenya.

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A central goal of paleoanthropology is to understand patterns of human evolution, including the timing of appearance of key adaptations, as well as speciation and extinction events. These patterns are often correlated to physical phenomena including regional tectonics or global climatic change. Here I assess the robusticity of known patterns in hominin species turnover during the late Pliocene and early Pleistocene with data from the Omo-Turkana Basin of Ethiopia and Kenya. The data derive from the Omo-Turkana databases, compiled by the author in collaboration with many colleagues, and include records of 245 hominins from the Shungura Formation, 17 records from the Usno Formation, 211 records from the Koobi Fora Formation, 58 records from the Nachukui Formation, and 50 records from the Kanapoi Formation. In the context of the vertebrate fossil record from this region (about 64,000 records of mostly fossil mammals), we can place confidence intervals on the first and last appearance of key hominin species: *Australopithecus anamensis*, *Kenyathropus platyops*, *Paranthropus aethiopicus*, *Paranthropus boisei*, *Homo rudolfensis*, *Homo habilis*, and *Homo ergaster*. The low abundance of hominin species in the context of the vertebrate fossil record from this region indicates that first and last appearances of these species remain poorly constrained. This conclusion suggests that as new research continues to improve the hominin fossil record, we should expect significant revisions to presently known patterns of hominin turnover.

The influence of grandmothers on sustained breastfeeding.

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In humans, there are known health benefits to breastfeeding, such as improved immune function, dental health, vision, hearing, digestion, and intelligence, and reduced risk of diabetes, heart disease, and central nervous system disorders. Some benefits are specific to the sustained breastfeeding period (past one year of age) and have lifelong effects. In evolutionary

terms, sustained breastfeeding may enhance survival and reproductive success.

In a recent study in Brazil, the close proximity of grandmothers increased the odds that mothers would cease breastfeeding during the first six months. Other research shows both positive and negative influences of grandmothers on infant feeding, offspring number and infant mortality. These findings are pertinent to the 'grandmother hypothesis', which explains increased postmenopausal longevity in humans as an adaptation allowing grandmothers to aid in the care and survival of her grandchildren, thereby increasing her reproductive success.

Here, we focus upon interrelationships between grandmothers and sustained breastfeeding in the northwestern United States. We held open-forum focus groups and interviewed mothers who had practiced various degrees and durations of breastfeeding. The results indicate that grandmothers influence initial feeding choices as well as the duration and level of sustained breastfeeding. The nature of this influence, however, depended upon the type of relationship and level of involvement of the grandmother. These results support the premise that reproductive success is linked to relationships between a grandmother and her descendants. Additional cross-cultural, longitudinal and historical data are needed to examine confounding factors, such as the grandmothers' dietary choices for her own offspring.

Dental ablation in ancient Nubia: evulsion at the Ginefab School site.

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Dental ablation, or evulsion, involves intentional removal of one or more teeth. It may be performed for many reasons and has been used to investigate health, medical treatment, marriage patterns, conceptualization of beauty and social roles in past and present populations. A systematic approach to the differential diagnosis of ablation was developed through the exclusion of tooth agenesis; antemortem loss due to trauma, disease, or aging; and postmortem loss. Using the criteria established, 96 individuals with observable dentitions were analyzed from the Ginefab School site, a cemetery upstream of the Fourth Cataract in northern Sudan that spans the end of the Meroitic period (c. 350 BC-AD 350) through the Christian period (c. AD 550-1400). Nine individuals (9.4%), all adults (12.7% of 71), show dental ablation. Eight of the nine cases (88.9%) involved removal of one to three mandibular incisors. Five of 41 males (12.2 %) and four of 30 females (13.3%) are affected. Ablation is more common in the late Meroitic to Post-Meroitic sample (6 of 51, 11.8 %) than the Christian period sample (3 of 45, 6.7%).

Dental ablation is known in Neolithic skeletal samples from Sudan, but has not been recognized previously in Nubians from more recent periods. The frequency and pattern in this skeletal sample suggests that tooth evulsion had a social/identity role in Meroitic to Christian period Nubians, but was not a rite of passage for

all. Expansion of this research to other Nubian skeletal samples is needed to elucidate the cultural significance of the practice.

This skeletal collection derives from fieldwork directed by Baker under licenses granted to Arizona State University by the US Department of Treasury, Office of Foreign Assets Control (Nos. SU-1897 and SU-2122), with support for fieldwork and lab processing provided by the Packard Humanities Institute (Award Nos. 07-1391, 07-1424, and 08-1472 [OFAC license No. SU-2071]) and The Regents of the University of California, and by the National Science Foundation (BCS-0647055).

Life stages, body proportions and locomotor behavior in captive *Pan paniscus*.

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Infant and juvenile chimpanzees face locomotor challenges as they develop their motor skills. Shifts in body proportions and tissue components underlie the observed transformation during locomotor development. We present anatomical data on 7 female *Pan paniscus* of known age (2 infants, 2 juveniles, 3 adults) based on whole body dissections that quantify body segments, muscle mass and bone tissues. Our results show that the limbs of infants under a year of age weigh 27.7% of total body mass, with significant mass to the distal segments, the hands and feet. They have only 22.0% total body muscle and of this, a remarkable 82.7% is in their limbs. In juveniles, limbs are nearly double, at 41.0% of body mass. Muscle increases to 43.5% of total body mass, with a similar proportion of muscle to the limbs at 83.8%. However, in contrast to infants, juveniles have heavy proximal segments (arms and thighs) with a decrease to hands and feet. Locomotor observations in captive *Pan paniscus* groups parallel these anatomical findings, demonstrating that each life stage has a distinguishing signal of behaviors (Zihlman, unpub; Grote et al. 2011, AJPA Suppl). Infants emphasize suspensory behavior and juveniles are more agile in the trees, whereas adults are less suspensory. These behaviors are consistent with field observations on *Pan troglodytes* where juveniles most often climb and jump, activities emphasizing different muscle groups than in infants or adults.

A future for morphometrics in anthropology.

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During the decade that the disciplinary home of geometric morphometrics has been physical anthropology, advances of pedagogy and software notwithstanding, our toolbox has ossified. I mean this literally: we typically exploit mainly information from surfaces of bones, as encoded by the location of "points that correspond," and typically we are content with ordinations. But the precision of our data sources

is now too high to claim credibility for this computed homology -- the point-correspondences lack all biological realism -- and ordinations have become inadequate to our scientific context. For information from bony surfaces to be biologically relevant it must be filtered and interpreted using information from the other kinds of machines that assess biological function instead of dead, ossified form. Tomorrow's morphometric analysis will have little use for either Procrustes distance or bending energy, as neither has any biological meaning. They will be superseded by new pattern-theoretic approaches that deal with biological form as only one descriptive channel among the many others serving the disciplines of the living organism, such as bioengineering, physiology, auxology, or the cognitive sciences. These data fusions, in turn, require novel approaches to multivariate data superseding the previous century's emphasis on static covariance structures by random walks, random textures, and other spatiotemporal process models. In summary, it is time for a new morphometric toolkit subordinating the variable aspects of geometry to the more important channels whereby quantitative anthropologists of the future will assess the meanings of form for function, growth, and natural selection.

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Simulated termite fishing in captive bonobos: an analysis of tool construction and socioecological factors influencing tool use acquisition and behavior.

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While there is a great deal of data on chimpanzee tool use from both the field and captivity, bonobo tool data comes primarily from captive experiments and indirect evidence of termite fishing from the field. Captive tool use studies have mostly been conducted under non-naturalistic conditions. This study investigates termite fishing in 16 naive captive bonobos by simulating naturalistic conditions using an artificial termite mound fashioned after those that occur in the wild. We found that bonobos were able to solve the task and constructed fishing wands in a manner similar to what has been described in chimpanzees, including detachment of raw material, side branch removal, leaf stripping, and bark peeling. We also found a similar female bias in tool behavior. Females attempted to fish ($F = 7.6707$, $p < 0.05$) and were successful more quickly than males ($F = 10.2792$, $p < 0.05$). Females fished with greater frequency ($G = 318.1310$, $p < 0.001$), had longer bouts, and had significantly more neighbors at the mound than did males ($F = 20.7260$, $p < 0.05$). 100% of individuals classed as high-rank succeeded, where 60.00% of mid-rank and 33.33% of low-rank individuals were successful. We also found that number of neighbors at the mound was positively correlated with rank ($r = 0.64835$, $p < 0.05$). Female bonobos can hold high rank positions and show greater cohesion, cooperation, and control of food sources than do their chimpanzee counterparts. The pattern of learning and use described in this study may

reflect socioecological conditions unique to this species of great ape.

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Group size, age, and reproductive state affect dominance in wild female Hanuman langurs (*Semnopithecus entellus schistaceus*).

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Female dominance hierarchies are assumed to be the consequence of the competitive regime with a nepotistic structure reflecting within-group contest competition for food. Hanuman langurs seem to be an exception with despotic, age-inversed hierarchies and individualistic, unstable ranks reported for a provisioned population with high levels of contest competition. It has also been assumed but not yet shown that females fall in rank after parturition. Here, we examine female dominance relationships and hierarchies through time in wild, unprovisioned Hanuman langurs at Ramnagar (Nepal); a population known to experience within-group contest competition. We observed one medium sized group (MG) and one large group (LG) averaging 6.9 and 13.6 adult females, respectively, for 5 years each between 1991 and 1997. Based on 12,490 dyadic displacement interactions, stable periods were identified ($N=14$ for MG, $N=31$ for LG) and dominance hierarchies constructed with the program MatMan. In both groups, dominance relationships had high directional consistency ($DCI > 0.95$) and hierarchies were significantly linear ($P < 0.05$). Rank was significantly negatively related with age, while the presence of maternal kin had no effect. Reproductive status affected dominance rank with females occupying lower ranks before conception and after birth. Ranks were overall unstable with the number of adult and juvenile females both contributing to this effect (multiple regression, $P < 0.05$). These results match earlier findings for a provisioned population. In female Hanuman langurs, competition seems to be most intense around conception, creating rank instability, which is further exacerbated by the number of adult as well as maturing females in the group.

Data collection supported by the Alexander von Humboldt Foundation, the Ernst Stewener Foundation, the German Academic Exchange Service, and the German Research Council.

The functional and ecological morphology of terrestriality in Primates and Non-Primate mammals.

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A primate's preference for terrestrial or arboreal substrates plays an important role in other aspects of its biology including its locomotor behaviors. Unfortunately, determining substrate preference in extinct taxa is difficult for obvious reasons. Morphometric indices have been developed based on the postcranial skeleton of living primates with known behaviors that distinguish terrestrial and arboreal species. These metrics have been used to reconstruct substrate preferences, and thus locomotor behaviors in fossil primates. Particularly discriminating regions of the fore- and hind limbs include the hand, elbow, shoulder and ankle. However, morphological indicators of behavior are products of their evolutionary history. Therefore, discerning skeletal indicators of substrate preferences that are related to adaptations to arboreal or terrestrial niches and less tightly correlated to phylogenetic history is essential for constructing useful models for understanding the evolution of fossil taxa. To define indices with the strongest functional signal, we collected morphometric data from readily fossilized postcranial elements including the proximal ulna, distal humerus, astragalus, calcaneus, and phalanges from a diverse sample of extant primates and non-primate mammals that contain terrestrial and arboreal forms (i.e., Carnivora, Rodentia, and Marsupialia). Using a supertree including branch lengths for all clades included in this analysis, we applied phylogenetic comparative methods to our measurements to explicitly calculate the phylogenetic signal reflected by each variable. Although some metrics were significantly influenced by phylogeny in some clades, others do prove to be reliable for identifying substrate preferences in living mammals, and therefore are useful in reconstructing behavior in fossil taxa.

A draft genome of *Yersinia pestis* from victims of the Black Death.

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Next-generation sequencing technologies have greatly expanded the scope of genetic analyses from ancient remains to the extent that genomic investigations are quickly becoming standard. This has important implications for infectious disease research as genomic data from ancient pathogens can help clarify their evolutionary histories and can speak to the complicated dynamics of host-pathogen

relationships and adaptation for emerging and re-emerging diseases. Here we report a reconstructed draft genome of *Yersinia pestis* from victims of the Black Death from London, England, 1348 - 1350 at 30 fold average coverage. Our ancient genome sits close to the root of all *Y. pestis* commonly-associated with human infection, with the most recent common ancestor dating to the 13th century at the earliest. This reveals that modern-day scourges of bubonic and pneumonic plague have their origins in the medieval era, and questions the etiology of the 6th - 8th century plague of Justinian, popularly assumed to have been caused by the same agent. At our current resolution the reconstructed genome shows no unique derived genetic motifs, provisionally suggesting that factors other than bacterial genetics may be responsible for the perceived epidemiological differences between modern and ancient forms of *Y. pestis* infection. This supports the notion that factors such as environment, vector dynamics, and host susceptibility should be central in epidemiological discussions of modern *Y. pestis* outbreaks.

Funding was provided by the Carl Zeiss Foundation (JK), the Human Genetics department of the Medical faculty in Tübingen (JK), the Canada Research Chair program (HNP, GBG), the Canadian Institute for Health Research (HNP), the Social Science and Humanities Research Council of Canada (KIB, HNP), the Michael G. DeGroot Institute for Infectious Disease Research (HNP), and the University at Albany Research Foundation and Center for Social and Demographic Research (SND).

Papa was a gnathostome (and Mama was dentate): modeling primate jaw and tooth evo-devo using a "toothless" mouse mutant.

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The evolutionary developmental (evo-devo) biology of primate jaws and teeth is vital to studies of human evolution for several reasons. Dentitions and jaw bones are often the best if not only fossil primate remains found. Jaw and tooth morphology is central to identifying many fossil taxa. Dental development data are the chief means of inferring fossil primate life histories. Thus it benefits paleoanthropologists to consider the genetic processes underlying observed variation in primate tooth and jaw morphology and development.

The challenge is doing experimental genetic work when it is not possible to study the oral-facial developmental biology of fossil or living primates for ethical or logistical reasons. A viable solution is to use a non-primate model. The laboratory mouse is classically used to study human oral-facial development. Taken further, mouse is a valuable model with which to address primate jaw and tooth evo-devo.

The molecular mechanisms that coordinate viable developmental and evolutionary changes in primate teeth and jaws are unknown. Using microarray gene expression studies we test the hypothesis that tooth and jaw

developmental timing is regulated independently of each other. We use a "toothless" p63^{-/-} mouse mutant with normal mandible development but failed tooth development. Importantly, this "toothless" mouse enables genetic studies of jaw development in relative isolation of odontogenesis. In "toothless" embryos aged days 10-13 we identified a tooth-exclusive suite of genes including collagen, keratin and claudin families. This supports the hypothesis that odontogenesis is regulated by a gene expression network independent of jaw development and, perhaps, evolution.

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Seasonality of infectious disease in Åland, Finland.

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Interest in seasonal patterns of infectious diseases is increasingly important given recent debates over the ramifications of global warming. Diseases are dynamic, responding to variations in temperature, rainfall, abundance of hosts, parasite biology, and resource availability. Seasonality also impacts geographic variation in onset, persistence, timing, and severity of epidemics. Hence, studying seasonality over a lengthy period provides a temporal reference useful for understanding and predicting how environmental trends will impact health in the future.

This study examines the effect of infectious diseases on populations residing in the Åland Islands, Finland, from 1650 to 1950. Primary data sources used are parish records of deaths and births kept by Åland's Lutheran ministers. The data consist of over 75,000 incidences of death. Environmental data consist of average monthly minimum and maximum temperatures, the amount of rainfall and number of wet days per month. The data are compared to seasonal variation during "normal" years for all deaths, not just those of infectious origin.

The results reveal a definite sinusoidal curve for some infectious diseases that are similar to the curve for total deaths. On the other hand, measles deaths display distinct seasonal patterns. Statistical analyses reveal infectious disease deaths correlate significantly with the seasonal pattern of total deaths, but these infectious diseases remain unique in their means and distributions. Further analysis identifies significant relationships between temperature and rainfall with total deaths and deaths from infectious disease. These patterns are discussed in relationship to seasonal patterns found in other populations and their driving environmental factors.

Research supported by a GRA position in the College of Liberal Arts and Sciences at the University of Kansas.

New earliest Eocene tarsal specimens of *Cantius* (Primates, Notharctinae) from central Wyoming.

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Morphological patterns among the earliest known species of fossil euprimates are important for reconstructing phylogenetic relationships and evolutionary origins of modern Primates. Species of *Cantius* and *Teilhardina* are the earliest known adapiform and omomyiform euprimates, respectively. Fieldwork in the Bighorn Basin has recovered a partial calcaneus and astragalus of *Cantius ralstoni* from sites stratigraphically tied to the Paleocene-Eocene boundary. These tarsals appear to be the earliest known for *Cantius*. We compare the new material to a sample representing other *C. ralstoni*, other *Cantius* species, and *Notharctus*. Additionally, we make comparisons to material of penecontemporaneous *Teilhardina*, as well as other fossil euprimates. Finally, our observations are put in the context of a generically comprehensive extant sample of strepsirrhines, tarsiiiforms, and platyrrhines. We utilize 3D models generated from microCT scans and preliminarily report results from five measurements: calcaneocuboid facet area, calcaneus total proximodistal length, calcaneus anterior segment proximodistal length; fibular facet slope; and astragalar trochlea width. Data show: 1) new *C. ralstoni* fossils are similar in size to other material known for this species. 2) As in previous work, no significant morphological trends through time except absolute size increase were documented for *Cantius* species; however, length of the anterior segment of the calcaneus was found to show significant negative allometry when regressed against measures of absolute size, which appears to explain previously noted differences in anterior segment elongation between *Cantius* and *Notharctus*. 3) The astragalar-fibular facet in *Cantius* is steeper on average than that in other sampled adapiform specimens and *Teilhardina*.

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Social proximity and egalitarianism among hunter-gatherers vs. farmers in the Central African Republic.

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Egalitarianism is a defining feature of forager culture but qualitative and quantitative research among non-foragers has shown that gender and age segregation in social and economic life occurs during middle childhood. In this study, I question if this developmental pattern holds among Aka forest foragers of the Central African Republic when compared to Ngandu farmers who emphasize age and sex hierarchy. I hypothesize that Aka children will continue to affiliate with the opposite sex and a wider range of ages to a greater degree across childhood than Ngandu children. I collected a detailed quantitative record of children's activities and social partners in both cultures. Controlling for structural features, frequency and variety of physical contact observed among Aka children was distinct from Ngandu children. Aka children were in physical contact with others twice as often as Ngandu children; half the observations of Aka children included touching; 14% of Aka children never touched someone, but 37% of Ngandu children never did; the Aka children were found to touch individuals of other age categories twice as often and individuals of the opposite sex three times as often as Ngandu children. Each of these trends is statistically significant and remains so across the age range sampled. Previous researchers have noted the high degree of physical contact among foragers. Based on ethnographic, neurophysiological, and endocrinological evidence I argue that this is a continuation of a forager attachment pattern that facilitates social bonding and helps to maintain egalitarianism and cooperation in Aka communities.

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The interpretation of shifting mortuary patterns after contact and colonialism.

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Christian mortuary rites and practices were considered an important component of the successful evangelization of native Andeans; however, historical documents account long-term campaigns to eradicate native mortuary practices and the persistence of the traditional indigenous beliefs and mortuary practices long after the first efforts of Christianization. In a previous paper (Murphy and Boza 2010), we proposed different indigenous strategies and responses to Spanish conquest and how these patterns might manifest themselves in the bioarchaeological record. We suggested that males and females may have been differentially affected by violence, disease, early evangelization efforts, and intermarriage. Here we integrate mortuary data with demographic information from Late Horizon (prehispanic) and early colonial burials from a cemetery that spans before and shortly after Spanish Conquest of the Inca Empire (N=119). These burials were analyzed and compared in order to test our expectations about mortuary practices and demographic statistics. We discuss the ratio of adults to subadults and the sex distribution and

sex ratio within the cemetery samples and what they might mean in terms of the toll warfare and disease may have taken on the males, females, and subadults from the community. We also present the observed shifts in mortuary practices and caution that there are multiple interpretations of the mortuary evidence for the effects of evangelization and Spanish Conquest and that the presence of Christian burials does not necessarily mean successful evangelization.

The *APOE* gene appears functionally monomorphic in chimpanzees (*Pan troglodytes*).

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In humans, the apolipoprotein E (*APOE*) gene is polymorphic, with three primary alleles that differ from each other at two key nonsynonymous sites. These alleles are functionally different in how they bind to lipoprotein particles, and this genetic variation is associated with phenotypic variation for several medical traits, including cholesterol levels, cardiovascular health, Alzheimer's disease risk, and longevity. The relative frequencies of the three primary alleles vary globally across populations. Moreover, it has been proposed that one particular allele (E3) might be a "meat-adaptive" variant associated with increased hunting and meat eating during human evolution. Studies comparing these human *APOE* alleles to the chimpanzee *APOE* sequence found that the chimpanzee sequence is most similar to the human E4 allele, although the resulting protein might function like that of the human E3 allele. This human-chimpanzee *APOE* comparison has been largely based on sequence data from a single chimpanzee, but it is potentially misleading to assume that chimpanzees have a single variant. To examine this, we sequenced the *APOE* gene, focusing on the functionally-important exons 3 and 4, in a total of 32 chimpanzees. This sample included 20 captive individuals representing the western subspecies (*P. t. verus*) and 12 wild individuals representing the eastern subspecies (*P. t. schweinfurthii*). Variation in our resulting sequences was limited to one non-coding, intronic single nucleotide polymorphism, which varied between the two subspecies. We found no coding (exon) variation within and between chimpanzee populations, supporting the claim that the human *APOE* polymorphisms are recently derived and human-specific.

Environmental risk and facultative adjustment of life history strategy in the Philippines.

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Life histories reflect strategies for allocating finite energy and time. Energetic constraints place limits on expenditures like growth and reproduction, while time constraints, such as reflected in high mortality rates, reduce optimism about living into the future and thus are predicted to lead to a "faster" life history strategy. In human females, theory predicts that both favorable nutrition and cues of high extrinsic mortality will lead to earlier maturity and more rapid reproductive scheduling. However, energetically stressful environments are often characterized by higher mortality, making it difficult to parse the relative effects of each on variation in life history trajectories. Here we simultaneously evaluate the importance of nutritional conditions and cues of mortality risk as influences on two key life history traits: age at maturity and reproductive scheduling. Data were collected across more than two decades in a large sample (n=669-784) of young adult women followed prospectively since birth as part of the Cebu Longitudinal Health and Nutrition Survey, in Cebu City, the Philippines. We find that measures of favorable energetic status, such as childhood growth outcomes, strongly predict earlier menarcheal age, whereas cues of environmental harshness are unrelated to maturational tempo. Adjusting for differences in menarcheal age, cues of environmental harshness do predict an earlier age of first sex, and among women who had had sex by 2009, higher parity. Our findings suggest that energetic conditions play a fundamental role as a constraint on maturational tempo in this Filipino population, whereas time constraints primarily shape reproductive scheduling.

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Genetics of social network position in free-ranging rhesus macaques.

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In human and nonhuman primates social behavior varies between individuals, yet the genetic and evolutionary basis of this heterogeneity remains poorly understood. Our goal is to determine genetic contributions to variation in social behavior in rhesus macaques living in a naturalistic setting on Cayo Santiago Island, Puerto Rico. Initially, we focused on two questions. First, is sociality heritable and, if so, is this variation associated with genes previously linked to behavioral phenotypes in humans and captive primates? We used quantitative genetics to estimate the heritability of social network position. We then explored the association between sociality and two repeat polymorphisms in the serotonergic pathway: the gene encoding tryptophan hydroxylase (*TPH2*) and the 5HTTLPR polymorphism within the serotonin transporter gene (*SLC6A4*). Behavioral and genetic data were collected from 87 adult rhesus

macaques in one group. Pedigrees were constructed using 29 microsatellite markers and length-polymorphisms assessed using PCRs. Using four social network measures, we found individuals' positions within the aggression and affiliation (i.e., grooming and spatial proximity) networks demonstrated significant additive genetic variation and are thus heritable. This variation may be partly explained by serotonergic polymorphisms. Rhesus macaques with high-functioning *TPH2* and 5HTTLPR alleles had significantly higher grooming network scores than individuals with low-functioning alleles. As the first large-scale study to examine behavior-genetic associations in a free-ranging primate, our results support the assumption that sociality has been shaped by selection acting on heritable variation and point to a potentially fundamental role of the serotonin pathway in the evolution of sociality in primates.

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Skeletal trauma in a Black South African Apartheid-era sample from the Raymond Dart Collection.

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This paper examines skeletal trauma in a sample of 27 apartheid-era Black South Africans (1945-1990) drawn from the Raymond Dart Skeletal Collection, Department of Anatomical Sciences, University of Witwatersrand, Johannesburg, South Africa. Autopsy reports provide information about the sex, age at death, year of death, ethnicity, and cause of death for each case. The sample was derived from individuals whose cause of death was from some form of malnutrition. Therefore the selection was random with respect to skeletal trauma. Nineteen of the 27 individuals (70%) exhibited skeletal trauma, including 6 of 8 females (75%) and 13 of 19 males (68%). Eleven of the 19 individuals with trauma (58%) had evidence of multiple traumatic events. Females experienced multiple nonlethal injuries to both the facial/maxillary and post-cranial areas of the body (e.g., ulna, ribs). Males experienced more nonlethal injuries to their cranial bones. A Fisher's exact test supports a statistically significant difference between female and male patterns of trauma. Even though individuals in this sample suffered quiet deaths from malnutrition there is clear evidence to suggest their lives reflected violent experiences. Overall, the data from this 20th century autopsied skeletal collection must be understood in a context that is linked to conflict and poverty of the apartheid-era, with noticeable differences in the types of trauma between males and females. Case studies such as this contribute to a greater understanding and recognition of interpersonal trauma that is applicable to establishing the osteological life histories of individuals.

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Twin brothers and sisters. Do they all floss?

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The purpose of this study is to unravel gender effects on preventive dental procedures and gingival bleeding, periodontal microbiome and oral malodor, using the co-twin study model. After a 2-week of supervised and unsupervised treatment regimen consisting of tongue brushing and tooth brushing, or tongue brushing, tooth brushing and dental flossing, twins were examined for gingival bleeding and oral malodor. Twins who flossed had a significant decrease in gingival bleeding when compared to twins who did not floss independent of age and gender ($p < 0.001$). Both treatment regimens demonstrated highly statistically significant reductions ($p < 0.0001$) in oral malodor adjusted for gender but the differences between groups were not statistically significant. In addition, a comprehensive analysis of the interproximal oral microbiome clearly showed that the combination of tooth and tongue brushing plus flossing had a significant effect on suppressing periodontal pathogens compared to the group that did not floss after adjusting for gender. Contrary to what is observed in dental caries, gender does not appear to influence periodontal parameters, oral malodor, and the interproximal microbiome in light of preventive dental procedures.

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Complications of co-morbidities: picking out skeletal indicators of scurvy.

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Conditions that were almost certainly due to vitamin C deficiency have been reported from a number of early texts, and it is likely that scurvy has occurred for a range of reasons since the adoption of agriculture, and possibly earlier. Being able to suggest that scurvy was present enables more nuanced biocultural interpretations to be made, but a significant problem for those dealing with archaeological human bone are the complications that co-morbidities can bring to suggesting a diagnosis.

Clinical studies have demonstrated that individuals with vitamin C deficiency are more likely to develop a range of pathological conditions and are also likely to experience pathological trauma. In archaeological bone picking out trauma associated with scurvy from other forms of trauma may be very difficult. Those with scurvy also frequently develop anemia, are more prone to infections and have impacted recovery, and the association with vitamin D deficiency (rickets) was noted as early as 1650. The full range of co-morbidities and traumatic changes are discussed, but this study focuses on picking out juveniles where vitamin C and D deficiency co-occurred. Macroscopic and histological features of both vitamin C and D deficiency are considered along with the impact of co-occurrence on each feature. For example, bone proliferation is normally rapid following ingestion of even limited vitamin C, but this will not be the case where vitamin D deficiency is

present. In many cases such approaches are unlikely to provide clear information unless used in combination with biochemical techniques currently being developed.

Divergence of catarrhine toll-like receptor 4 predicted shape and electrostatics and the evolution of LPS-mediated sepsis resistance in Old World Monkeys.

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Sepsis is a deleterious, systemic innate immune response to immune insult (i.e., pathogens, pathogen components). Despite high genetic similarity, some hominoids and cercopithecoids differ in susceptibility to gram-negative bacterial sepsis (i.e., *Escherichia coli*). Humans and chimpanzees are highly sensitive to *E. coli* and its cell wall component Lipopolysaccharide (LPS), requiring only small doses to initiate a severe acute inflammatory response. Baboons and macaques, however, are *E. coli*/LPS insensitive and require high doses to establish minimal symptoms. The Toll-like receptor-4/Lymphocyte antigen-96 (TLR4/LY96) complex detects LPS and can initiate profound cell activation associated with sepsis. To test if TLR4/LY96 structure and electrostatic potential has diverged in humans, chimpanzees, baboons and macaques, these proteins were comparatively modeled. Best models and known human and mouse structures were examined for charge, sidechain orientation, and shape differences. While LY96 shape and charge were conserved across species, the TLR4 LPS binding region showed significant inter-family differences in electrostatic potential. Baboon and macaque LPS-binding regions are strongly negatively charged, while human, chimpanzee and mouse LPS binding regions show a complex topography of uncharged and charged residues. These results suggest that baboon/macaque TLR4 evolved a weaker binding affinity to the negatively charged LPS than humans, chimpanzees and mouse. Additionally, an 11 amino acid deletion in the TLR4 intracellular signaling domain in baboon/macaques truncates the modeled domain and may affect cell activation. These results suggest that cercopithecoid TLR4 structure and charge have significantly diverged from that of other mammals and may affect LPS binding, cell activation and susceptibility to sepsis.

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Hard tissue research on Sub-Saharan Africans of known life history.

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We are collecting skeletal samples of sub-Saharan Africans of Bantu origin and known life history derived from the University of Malawi College of Medicine (UMCOM) to test hypotheses regarding microanatomical concomitants of human body size variation and to establish the first publicly accessible bone and tooth tissue bank of sub-Saharan Africans of known life history. Bone and tooth tissues are acquired from the thigh and leg (midshaft femur and tibia/fibula), foot (3rd metatarsal), arm and forearm (midshaft humerus and radius/ulna), hand (3rd metacarpal), vertebral column (3rd lumbar vertebra), rib cage (midshaft 6th rib), and lower jaw (one half-mandible); the sampling of many skeletal locations will permit a more thorough evaluation of histocompositional variability. For each cadaver UMCOM staff administer a questionnaire to next of kin, in which medical, social, economic and life history information is sought, offering the possibility to interpret the long-range effects of environment, diet, and lifestyle for studies in fields that have links to sociocultural, archaeological, and biological anthropology—e.g., medical anthropology, paleoanthropology, auxology, forensic osteology, and human ecology. To date, 20 adolescent-young adult individuals have been sampled; we expect to sample 100 individuals by 2014. Preliminary results of the effects of the environment on bone structure will be presented, and we will provide public online links to images, data, and information concerning open access to study materials.

This project is supported by the National Science Foundation (BCS-1062680) and by Max Planck Society and Alexander von Humboldt Foundation support of the Hard Tissue Research Program in Human Paleobiomics.

Reconstructing the habitat mosaic associated with *Australopithecus robustus*.

JULIET K. BROPHY. Anthropology, Loyola University Chicago.

This research is designed to test the recurrent suggestion that *Australopithecus robustus* were habitat specialists, preferring an environment consisting of predominately open to lightly wooded grasslands situated within a larger habitat mosaic. Establishing the habitat associations of *A. robustus* holds important implications for understanding the behavior of these hominins and, potentially, for determining whether climate change influenced their ultimate extinction. To this end, fossil bovids are widely recognized as valuable ecological indicators, useful for reconstructing paleoenvironments associated with early hominin remains. The bovids associated with *A. robustus* from Cooper's D and Swartkrans Members 1, 2, and 3 were identified using a reliable, standardized approach involving Elliptical Fourier Function Analysis. This approach involves digitizing the occlusal surface of bovid teeth, calculating an average outline for each tooth/species, and statistically comparing the quantified tooth shape to other closely related bovids. More accurate identifications of fossil bovids provide for more precise estimates of their relative abundance, allowing for finer resolution of the reconstructed habitat mosaics. The relative abundances of bovids and of robust australopithecines in each of the

assemblages were compared in a temporal sequence to determine the habitat associations of these hominins. *A. robustus* were not statistically correlated with any particular habitat type as reconstructed from the bovid assemblages, suggesting that the grasslands that the hominins are typically considered to have occupied might not reflect their habitat preference. *A. robustus* likely occupied multiple types of habitats, suggesting that they were habitat generalists rather than habitat specialists.

Japanese-Americans show increased frequency of diary reports of negative moods compared to other ethnic groups during the peri-menopause: the Hilo Women's Health Study.

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Peri-menopausal women experience elevated frequency of psychological distress and depression, and there are significant differences between ethnic groups in the rate at which these symptoms are experienced. These differences may be due to socioeconomic, health, and cultural factors, including culturally-based reporting bias. Accordingly, in a study of women aged 45-55 in the multiethnic population of Hilo, Hawaii, comparisons between Japanese-Americans (JAs) and women of other ethnic backgrounds were carried out for the frequency and severity of negative mood (anxiety, sadness, anger) reports of women who kept a 24-hour diary. For the frequency of negative reports, there was a significant difference between women based on menopausal status (pre-menopausal, peri-menopausal, post-menopausal; ANOVA, $F = 4.0$, $p < .05$), but not based on Japanese ethnicity ($F = 0.8$, ns); there was a significant interaction between ethnicity and menopausal status ($F = 3.3$, $p < .05$), with JAs have significantly greater frequency of negative mood reports than other women during the peri-menopause. Similar results were found for the reported severity of negative moods (status: $F = 4.9$, $p < .01$; ethnicity: $F = 0.7$, ns; status X ethnicity: $F = 3.7$, $p < .05$). When analyses controlled for family income level and educational attainment, JA ethnicity remained a significant predictor of negative mood severity among peri-menopausal women. Reported health status and JA ethnicity are significant predictors of negative moods in peri-menopausal women in this multiethnic sample.

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Preliminary analysis of human skeletal remains recovered from a mid-nineteenth century cemetery in downtown New Haven, CT.

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In July 2011, construction at Connecticut's Yale-New Haven Hospital was interrupted by the discovery of human skeletons. These remains were exposed via trench excavation, and lay under a large concrete foundation slab poured in the 1970s. Review of historical records and maps indicate that these remains are associated with New Haven's first Roman Catholic Church, from a cemetery dating between 1834 and 1853.

Four adult human skeletons were recovered, with few associated artifacts. Many of the skeletal elements have postmortem damage, but the remains are remarkably well-preserved overall. Two of the skeletons are female, one aged 25-35 years, and the other possibly 60-70 years of age. The other two are male, one also 25-35, and the other over 60 years of age. Both younger individuals have remarkably complete and unworn dentition, while both older individuals show antemortem tooth loss and extreme dental wear. The younger male shows marked calculus accretion and periodontal disease, and the older male exhibits multiple healed fractures to the cervical vertebrae and ribs, suggesting significant (but ultimately survivable) trauma. All individuals show indications of manual labor such as compressed vertebrae, strong muscle markings (especially on the males), and arthritic changes to many joints.

Here, we present data on stature, ethnicity, and health. We also describe ongoing collaborative work to identify and elucidate the context of these individuals within New Haven's history and society.

This work was supported by the Connecticut Office of State Archaeology and the Yale University Department of Anthropology.

Invertebrates provide substantial energy and protein for redtail monkeys (*Cercopithecus ascanius*) in Uganda.

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Redtail monkeys (*Cercopithecus ascanius*) are traditionally considered frugivorous, but invertebrates can compose a large part of their diets in some areas. We examined the nutritional contributions of insects in the diets of redtail monkeys in Kibale National Park, Uganda by conducting full day focal follows of adult females in one group from August 2010 to August 2011. Female redtails spent 63% of their foraging time eating insects (including solitary insects and leaf galls), 22% on reproductive parts of plants (including ripe fruit, unripe fruit, flowers, seeds), and 15% on leaves (including young leaves, mature leaves, leaf petioles, leaf buds). Redtails fed primarily on solitary insects, such as cicadas and crickets, as opposed to social invertebrates. Of the consumed insects that could be identified, 81.6%

were cicadas (Order Hemiptera), 4.3% were grasshoppers (Order Orthoptera), 0.5% were crickets (Order Orthoptera), 13.5% caterpillars (Order Lepidoptera). Insects were fairly low in fat (<10%), very high in crude protein content (mean = 69%, range = 39 – 78%), and contained moderate amounts of chitin (ADF mean = 16%, range = 8 – 36%). Insects, rather than fruits and leaves contributed the majority of protein and energy in the redtail diet; over 50% of protein and over 50% of energy were obtained through insectivory according to weight-based estimates of food intake. Our findings demonstrate high insectivory in the diet of a species traditionally categorized as a frugivore and indicate that the nutritional importance of invertebrates in the diets of some primates has been underestimated.

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Categorising evolution: moving beyond the binary.

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Essentialism (the belief that objects and concepts have unchangeable, deeply intrinsic qualities) and the dichotomies that often result from such a thinking pattern shape the assemblage of concepts with which we humans perceive our surroundings. Consequently, we tend to pigeonhole our world into dualistic categories such as black/white, animal/human, male/female, heterosexual/homosexual, nature/culture, body/machine or good/bad – an inclination that is particularly well reflected in Cartesian Western philosophy. Such a binary approach is certainly practical, as it allows us to decide and communicate quickly and also provides some sense of security. A social anthropologist might not hesitate to understand dualisms as social constructs or “adaptive prejudices” that do not necessarily describe physical or biological realities correctly. A biological anthropologist, on the other hand, works much more readily within dualistic frameworks – and therefore encounters conceptual problems with phenomena such as hybrids, intersexuality, bisexual sexual behaviour or humans who depend on pacemakers. As a case study, I analysed how a traditional binary construct (apes versus humans) is subject to shifting boundaries in reports of UK newspapers over the last two decades. My analyses reveal that when scientific findings deconstruct existing dualistic categories, that these are not dropped, but simply readjusted – in both the popular as well as the academic discourse. This finding questions the objectivity of evolutionary theory and highlights the need to develop a non-dualistic framework of scientific thought.

The development of the maxillary dentition in newborn strepsirrhine primates.

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For a given skull size, folivorous primates typically have larger and earlier erupting postcanine teeth than frugivorous species. To determine whether these dietary adaptive signals can be discerned at birth, microCT slices and serial histological sections of the crania from 28 perinatal strepsirrhines (17 species) were studied. Presence or absence and stage of maturation of deciduous and permanent maxillary teeth were assessed, and dental sac volumes were measured across species relative to cranial length (prosthion-inion). The total number of permanent teeth present at birth is greatest in *Propithecus verreauxi* and lorisoids. In these species, dental sacs for nearly all permanent maxillary teeth could be detected at least at the bud stage; in *Propithecus* each replacement premolar had developed to the bell stage. Lemurids possess the fewest permanent teeth that have progressed to the bud stage or beyond, especially *Varecia variegata* where only C and P² are present. Cube roots of dental sac volumes are tightly correlated with cranial length, especially dp⁴ (R²=0.95). MicroCT slices suggest mineralization of dp⁴ and M1 is more advanced in the folivorous *Propithecus* and *Hapalemur griseus* compared to similar-sized frugivores. Preliminary results also indicate dental sac volumes are proportionately large in *Hapalemur* and *Propithecus*. These findings suggest that perinatal dental size and maturation do correlate with diet in strepsirrhines. Specifically, perinatal dental form reflects a folivorous lifestyle in that replacement dentition is relatively precocious (as exemplified by *Propithecus*) and/or posterior maxillary dentition (dp⁴ and M1) are relatively enlarged.

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Paranasal sinus shape in Pleistocene hominins.

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Homo heidelbergensis and *H. neanderthalensis* are reported to have distinctive paranasal sinuses; increased lateral extension of *H. heidelbergensis* frontal sinuses is one of very few hypothesized unique traits of this controversial taxon. Neanderthal frontal sinuses are also said to differ from those of humans in not pneumatizing the frontal squamae. Investigating these assertions could illuminate the causes of craniofacial variation between species.

Using CT data (*H. heidelbergensis*, n=3; *H. neanderthalensis*, n=5; fossil *H. sapiens*, n=5; recent *H. sapiens*, n=16), virtual 3D reconstructions were created using AVIZO and the frontal sinuses segmented. 2D projections were used to measure sinus height and width relative to craniometric landmarks. Data were

analysed using PCA and non-parametric statistics.

While *H. heidelbergensis* frontal sinuses are more likely to extend further laterally, each species contains individuals where the sinus extends past the orbit midpoint. Sinus shape does not distinguish between *H. heidelbergensis* from Europe and Africa. Sinus height does not differ significantly between species, suggesting no difference in pneumatization of the frontal squamae.

As these variables fail to distinguish between species, frontal sinus shape may not be taxonomically diagnostic for Pleistocene hominins. Neanderthal sinus shape is not unique, thus specialised pneumatization is probably not the cause of the distinctive Neanderthal face. The taxonomic possibilities of differences in other sinus measurements, such as surface area and volume, must be explored and more powerful methods, such as geometric morphometrics, must be employed to test other possible correlates of craniofacial form, such as climate and masticatory forces.

‘From Cemetery to Clinic’: 3D Digitised pathological data from archaeological leprosy skeletons.

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The ‘From Cemetery to Clinic’ project produced 3D laser scans of skeletons with leprosy from the medieval *Leprosarium* of St. James and St. Mary Magdalene, Chichester, UK. The collection is one of the largest published cemeteries with skeletal manifestations of leprosy. In addition, site plans, excavation data and radiographs were digitised and incorporated into an interactive website. The website also presents descriptions of the clinical manifestations of leprosy, alongside a valuable collection of clinical radiographs of leprosy individuals.

The project aimed to ensure that fragile pathological remains can be accessed widely by students, the public and other diverse groups whilst having a low impact on the remains themselves. In addition the project aimed to provide globally accessible reference material for clinicians to aid their diagnoses of leprosy changes in patients.

This poster presents the methods used to produce high-resolution 3D digital models of the skeletal remains using a FARO Quantum arm 3D laser scanner and will examine the benefits and methodological challenges of combining the high resolution models with high-pixel count digital photography to accurately colour and texture a significant proportion of the models.

This project was funded by JISC under the rapid digitisation scheme.

Scaling and developmental integration in the *Paranthropus* head.

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The *Paranthropus* head is characterized by a number of features traditionally thought to be related to heavy chewing, including large, thick-enameled cheek teeth, a tall mandibular ramus and face, thick palate, and large, flaring zygomatic arches. McCollum [Science 284 (1999): 301-305] proposed that palatal thickening is a response to developmental integration between a tall mandibular ramus, oral and nasal functional matrices, and the vomer, which inserts onto the premaxilla in *Paranthropus* and thus causes the palate to thicken instead of rotate during vertical expansion. In this study, we tested whether palate thickness increases as a byproduct of differential increases in size of the oral and nasal functional matrices related to growth in the mandibular ramus. To test this hypothesis, we collected 3D volume and landmark data from computed tomography (CT) scans of orangutan, gorilla, chimpanzee, and modern human skulls, and crania for fossil hominin species including *Australopithecus africanus*, *Paranthropus robustus*, and *P. boisei*. Following McCollum's model, we hypothesized that palate thickness and nasal cavity size would scale with positive and negative allometry, respectively, relative to posterior facial height, and that nasal cavity size would scale predictably with cranial proxies for body size. Against expectation, palate thickness does not correlate with posterior facial height, and nasal cavity size scales with isometry or slight negative allometry. Moreover, nasal cavity size is only moderately correlated with cranial size proxies. These results suggest that developmental constraints related to growth counterpart relationships in the skull are unlikely to affect palate thickness in the genus *Paranthropus*.

Postcanine tooth size in anthropoid primates in relation to dietary behavior.

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Previous studies have demonstrated how molar size scales with body mass across primates, and this relationship has important implications for inferring body size and dietary adaptation in fossil primate species. However, there are many instances among primates in which this general relationship is not applicable to individual species, where postcanine tooth size is disproportionate relative to body size. This study investigates the relationship between postcanine megadonty and microdonty and dietary behavior among extant anthropoid primates. In particular, it examines the way relative postcanine size varies across taxonomic subgroups and between sexes and quantifies the relationships between different measures of postcanine megadonty, as well as how individual teeth contribute to overall postcanine tooth area. The results show that the taxonomic level at which the analysis is performed has an effect on the relative degree of megadonty in individual species and demonstrate that there is no simple

relationship between megadonty and diet among primates and that a combination of dietary behavior, mechanical properties of the foods, cranial architecture and phylogeny may play a part in relative postcanine dental size. These findings imply that caution is necessary in making direct inferences about dietary behavior of fossil species, including hominins, based on the relative size of the postcanine dentition.

A new method of dentine microsampling of deciduous teeth for stable isotope analysis.

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Serial sampling of the dentine for carbon and nitrogen stable isotope analysis can be used to reconstruct individuals' changing diets and dietary habits of populations. Previous serial studies have used homogenized samples that give broad results. This study presents a new microsampling technique for use with stable isotope analysis that reconstructs diet associated with specific juvenile life stages: fetal life, breastfeeding, and weaning.

A sample of 23 modern deciduous teeth was collected in collaboration with the Department of Pediatric Dentistry, University of Alberta. The teeth were longitudinally sectioned. One half of each longitudinally cut tooth was examined histologically to find the level of the neonatal line and the other half sampled for isotopic analysis. Microsamples of dentine were collected occlusal to the neonatal line, directly apical to the neonatal line, and from the growing edge of the tooth. Collagen was extracted from the samples using standard procedures modified for small samples.

Preliminary results of the stable isotope analysis show $\delta^{15}\text{N}$ shifts across the neonatal line of some teeth that are consistent with the transition from fetal life to breastfeeding. Current work focuses on adjusting the sampling protocol to consistently provide microsamples above the threshold weight needed for accurate simultaneous carbon and nitrogen analysis. Work is also being done to apply the method to archaeological remains.

Are root dimensions linked to mandibular robusticity in the common chimpanzee (*Pan troglodytes verus*)?

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During mastication, forces are applied to the dentition and mandible according to the properties of the food particles. Mandibular and dental morphology is related to diet or more specifically, to different mechanical loads applied during mastication. For example, species with a "hard" diet show a more robust (broad) mandibular corpus than species feeding on a "soft" diet who exhibit a taller and more gracile

corpus. Recent studies have linked crown size and mandibular morphology to chewing function. Root dimensions, however, are of particular interest since the periodontal ligament attaches the root to the alveolar bone and acts as a shock absorber. Therefore, more ligaments would be found on a larger root surface area which could tolerate higher occlusal forces.

We test the hypothesis of a positive correlation between molar root dimensions and mandibular robusticity and expect to find large root surface areas together with a high robusticity index (broad mandible). Using μCT data from more than adult chimpanzees (*Pan troglodytes verus*), we quantify root length, root surface area, root volume and cervical area in the molars. The robusticity index is measured at coronal cross sections of each tooth.

Root dimensions and cross sectional shape vary along the molar tooth row within an individual. We find overall high levels of variability within our single species sample and findings point to a complex functional and/or spatial relationship between root dimensions and mandibular size.

Clovis tools or Clovis people? A new approach using time-series conversion and dynamic time warping.

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The peopling of the Americas has been studied extensively, but no decisive conclusion has been reached as to whether the people of the Clovis culture were the first inhabitants of the Americas. Recent archaeological finds suggest that both North and South Americas were inhabited prior to the emergence of the Clovis culture. In this paper, we ask, "Was the spread of Clovis a biological (migratory) or cultural process?" If it were cultural, the Clovis-first hypothesis would be incompatible.

Using an innovative method from computer science, we transformed photographs of Clovis tools into time-series. We analyzed them with dynamic time warping, a method of comparison. We analyzed Clovis tools ($n = 31$) from four North American Clovis sites (Anzick, MT, East Wenatchee, WA, Lehner, AZ, and Murray Springs, AZ). Variation in tool morphology within a site was compared to variation between sites. Preliminary results show that East Wenatchee has the lowest within-site variation (consistent with it being the earliest of our sites), but all sites have low within-site variation compared to the between-site values. Anzick and Murray Springs show the greatest between-site variation. The degree of difference between early and later sites (about 150 years of separation) indicates that Clovis technology spread too rapidly and with too much variation to be spread by migration alone. The Clovis tool kit spread via cultural exchange, and we conclude that there were people already living in North America prior to the appearance of the Clovis culture, rejecting the Clovis-first hypothesis.

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Occupational mobility in nineteenth century rural England: the interpretation of enthesal changes.

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The identified individuals from Fewston churchyard, North Yorkshire, span the period when the first censuses were undertaken in England. This allows occupation to be studied in depth for each individual through time. The aim of this study is to highlight occupational mobility. The hypothesis was that occupational mobility would increase the likelihood of enthesal changes (EC) due to changes in loading patterns caused by changes in tasks undertaken.

Materials and Methods: Only identified adult individuals were included in this study (males n=10, females n=7). All individuals were recorded blind by Henderson based on a list compiled by Caffell. Degenerative joint disease (DJD), fractures, and signs of boneforming disease were recorded. EC were recorded using the presence/absence method defined by Villotte. Occupational mobility was defined as: a change between heavy manual and either non-manual or light manual work or vice versa (e.g., servant to farmer).

Results: 29% of females and 45% of males changed occupation. Differences were not tested for the females. It was found that the median age of the males who changed occupation (median: 78) was higher than that of those who did not (median: 41). Frequencies of DJD (24% versus 31%) and those of EC (48% versus 67%) were higher in the occupational change category.

Discussion: The small sample size and the difference in age between the two categories likely explain the findings. However, understanding the effect of occupational mobility on EC is vital for the study of occupation in the past.

Spatio-temporal distribution of food resources and group-level memory shape inter-group contact patterns in white-faced capuchins (*Cebus capucinus*) and Verreaux's sifaka (*Propithecus v. verreauxi*).

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Socio-ecological models predict that food resource distributions should fundamentally influence social interactions within and between primate groups. For example, clumped, defensible food resources should promote aggressive between-group interactions while large, low quality feeding patches should merely cause indirect, density-dependent competition. However, these models do not tell us where and

how often inter-group contacts should occur—information critical for understanding the transmission of information, behavioral traits and infectious diseases in primate populations. Here, we describe an extension of the socio-ecological model that includes both heterogeneous food resource distributions and group-level memory of prior feeding spots and inter-group encounters. We use a novel maximum-likelihood framework to fit this model to fruit tree distribution and extensive movement data collected for five capuchin groups from Barro Colorado Island, Panama. We then apply the estimated model to a completely different system, folivorous Verreaux's sifaka from Madagascar, modifying only the food resource distribution to match that observed in Kirindy Mitea National Park. The model predicts that sifaka should display lower inter-group aggression rates, larger home-range overlap and lower feeding site re-visitation rates than capuchins. All of these predictions are consistent with direct behavioral observations collected for two years in five neighboring sifaka groups, suggesting that food resource variability and spatial memory jointly and profoundly shape group-level contact patterns.

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Recombination networks as genetic markers in a human variation study of the Old World.

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We have analyzed human genetic diversity in 33 Old World populations including 23 populations obtained through Genographic Project studies. A set of 1536 SNPs in five gene-free X-chromosome regions were genotyped in 1288 individuals (mostly males). We use a novel analysis employing subARG network construction with recombining chromosomal segments, by using the IRiS software (freely available at https://researcher.ibm.com/researcher/view_proj

[ect.php?id=2303](https://researcher.ibm.com/researcher/view_proj)). A subARG is constructed independently for each of five regions and the results are aggregated across them. The observed population structure supports genome-wide frequency-based analyses: African populations show higher genetic diversity, and the general trend of shared variation is seen across the globe from Africa through Middle East, Europe, Central Asia, Southeast Asia, and East Asia in broad patterns. The recombinational analysis was also compared with established methods based on SNPs and haplotypes.

We also estimated effective population sizes; Sub-Saharan African populations have effective population sizes that are ~4 times greater than those of non-African populations. Outside of Africa, South Asian populations had the largest effective sizes. Additionally, recombination diversity correlated with distance out of Africa through a South Arabian, but not a Sinai, route, and, within Eurasian populations, recombination distance correlated with distance from Southern India.

Our recombinational analysis suggested a southern migration route out of Africa, and it also supports a single, rapid human expansion from Africa to East Asia through South Asia, with a larger role than previously envisaged for South Asia in the demographic history and population expansions of anatomically modern humans out of Africa.

Measuring the contribution of genetic and non-genetic factors to variation in stress physiology in a captive population of male baboons (*Papio* sp.).

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Since steroid hormones mediate many gene-behavior interactions, determining sources of their variability within and between individuals is crucial to understanding the processes intervening between genotypes and behavioral phenotypes. Recently, we reported that testosterone variation was highly heritable ($h^2 = 0.692$, $p < 0.001$) among 250 adult male baboons (*Papio* sp.) sampled from a genetically diverse, pedigreed population housed at the Southwest National Primate Research Center (San Antonio, TX). Using the same set of steroid-extracted samples ($n = 947$) collected from these males, here we assess whether variation in fecal glucocorticoid (fGC) concentration can be attributed to genetic factors under optimal experimental conditions for detecting them, *i.e.*, with substantial genetic diversity, and environmental variation minimized. Non-genetic variation was either eliminated (diet, temperature, weather, circadian effects, predation) or incorporated into analyses as covariates (age, weight, presence of females, social status, taxonomy). Variance components methods were used to estimate the proportion of total variance in fGC concentration attributable to genetic variation and to all (non-genetic)

covariates. We were unable to detect a statistically significant genetic effect on fGCs in this population ($h^2 = 0.034$, $p = 0.35$). Among non-genetic variables, only age had a statistically significant, but small (<5%), effect on total fGC variance ($p < 0.01$). Since our previous analyses using these samples found individual differences in fecal androgen levels to be highly heritable, this study suggests that interindividual variation in HPA axis function may be more sensitive to environmental effects and less influenced by genetic differences than reproductive steroids.

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Did the origins of human language involve changes in the insula?

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Robin Dunbar has argued that language represents the human equivalent of grooming among primates. Both activities act to promote affiliation among individuals, but the fact that language communicates over a distance allows for the maintenance of a larger group size. Both modes of communication serve to increase the benefits of group member. While Dunbar's argument has attracted much attention, he has not offered a clear evolutionary mechanism by which the neurological effects of physical touch could be taken over by the impact of the spoken word. Here I hypothesize that the shift from reliance on physical touch to auditory communication represents a shift in the importance of sensory inputs within the insula, an area of the brain concerned with the representation of somatic well-being. Prosody or the emotional content of language is known to be processed in the insula. Recent findings among rhesus macaques that species specific vocalizations directly stimulate neuronal firing in the insula suggest an evolutionary precursor for the emotional component of language. At the same time, results among humans demonstrating that physical caress of hairy skin results in activity in the insula suggesting that physical touch may have become restricted to more intimate relationships among humans relative to primates. Together these findings provide support for the decreased importance of touch and increased role of vocal communication for group communication in humans. This hypothesis provides a testable scenario by which Dunbar's gap between grooming and language may have been transverse through the course of human evolution.

Population assessment of Demidoff's dwarf galago (*Galagoide demidovii*) in a Ghanaian forest fragment mosaic.

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Demidoff's dwarf galago (*Galagoide demidovii*) is a widespread resident of Central and West African forest understorey and edge habitats. We surveyed for *G. demidovii* between July 2008 and June 2009 in Boabeng-Fiema Monkey Sanctuary (BFMS), Ghana. This 192-ha forest fragment is mostly surrounded by farmland and consists of primary and disturbed forest, closed woodland, and derived savanna. Although a centuries-old hunting taboo in BFMS has successfully conserved two monkey species, *G. demidovii* was not afforded any protection from hunting until recently. We aimed to assess the current population of *G. demidovii* at BFMS and to examine the galagos' differential use of habitats. Pairs of observers walked line transect routes totaling 28.2-km that were distributed among all forest types. We searched for galagos by their eye shine reflected from headlamps. For each detected animal ($n=41$), we recorded microhabitat characteristics and the perpendicular animal-to-transect distance. A sharp reduction in detections beyond 10-m indicated that the effective transect width was 20-m. Galago density was 0.41 animals per hectare, suggesting a total population of approximately 78 animals. We observed galagos in all habitat types, but they were disproportionately common along road/forest edges with a dense, liana-rich understorey and uncommon in tall primary forest with a sparse, open understorey. The mean height above the ground of detected animals was 4.2-m. Our surveys indicate that despite the isolation and history of heavy human impact at BFMS, a sizeable population of *G. demidovii* persists at a population density that is comparable to those in continuously-forested, undisturbed areas.

The Neolithic transition in the Maghreb: a study through dental morphological data.

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The present study assesses diachronic relations among the different populations that have, inhabited the Maghreb during the transition to the Neolithic. Even though there is a general consensus regarding a Near, or Middle, Eastern origin of this transition that has determined indisputable changes in subsistence throughout the Mediterranean basin, its modalities and extent are still far from resolved. Two principal scenarios have been hypothesized: demic diffusion and cultural transmission; the first envisaging a change in the region's genetic pool and the second, population continuity. In order to establish if there has been continuity in the Maghreb, the present study analyses the bearers of the Neolithic culture and establishes the relations they had with each other and with the populations that preceded them. It, furthermore, evaluates if the adoption of a Neolithic subsistence along the southern shore of the Mediterranean was an independent process or if, on the contrary, it was part of a wider phenomenon which interested, from the Near East, a great portion of the Old World. The results, indeed, seem to strongly suggest this transition was accompanied by consistent

population replacement and that the Neolithic revolution spread in different directions. In particular, they seem to indicate routes along the northern and southern coasts of the Mediterranean, towards the Arabian Peninsula and along the shores of the Nile valley.

When evolution hurts: height, arthritis risk, and the regulatory architecture of *GDF5* function.

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Modern humans display marked variations in many biological traits, although their genotypic basis remains largely unknown. Much of this variation is thought to be due to regulatory mutations occurring in non-coding genomic regions. The *Growth and Differentiation Factor 5* (*GDF5*) gene encodes a bone morphogenetic protein that controls both epiphyseal chondrocyte maturation and synovial joint formation. Recent studies have shown that high frequency genetic variants in *GDF5* are significantly associated with both stature and osteoarthritis susceptibility in human populations. Although these associations have been highly replicated, the causal base pairs controlling height and arthritis risk are still unknown. Here we use studies in transgenic and knockout mice to identify the regulatory regions controlling normal *GDF5* expression and function. Scanning studies with large Bacterial Artificial Chromosome (BAC) clones shows that key *GDF5* regulatory sequences are located over a large physical interval both 5' and 3' prime of the gene. Multiple small enhancers map within these regions, each controlling expression in separate skeletal structures, including growth plates or individual synovial joints in the limb. Several of these enhancers map in the genetic interval that is strongly associated with both height and arthritis risk in humans. Molecular signatures suggest that a variant regulatory block at the *GDF5* locus has been the target of strong natural selection during recent human evolution, particularly in out-of-Africa populations. Past selection at the locus has driven some human regulatory variants to very high frequency, with important consequences for the overall risk of arthritis in modern populations.

Secular change is context dependent: an example from Portugal.

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This paper cautions general assumptions about secular change in Portugal during and after the industrial revolution as mirroring those of other Western countries, such as in the UK or the US. The social, economic, demographic and political history of Portugal was unlike that of these countries and, consequently, the Portuguese experienced a very different pattern of secular changes. In this study femur length, as

a surrogate of stature, is compared between two samples of male (n=130) and female (n=130) skeletons from two different collections in Lisbon Portugal, representing a 150 year time span. One sample represents the early 19th century, whereas the other the middle 20th century. The older sample is derived from the Ferraz de Macedo collection and the more modern from the Lisbon collection, both housed at the National Museum of Natural History in Lisbon Portugal. Results show that between the early 19th century and the middle 20th century, there are no significant changes in femur length. In addition, while mean femur length in females increased slightly, in males it decreased. This suggests that secular changes favoring growth did not take place during this time period, as it occurred in the US or the UK. In light of these results and of documented political, economical and social changes, the general Portuguese population experienced only minor improvements in living conditions, and hence was under no significant secular change process. Significant environmental changes came later and were mostly experienced by those born after 1960.

Chimpanzee consumptive behavior associated with diurnal nutrient cycling.

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Primatologists have long observed diurnal variation in the consumption behavior of wild chimpanzees, with young leaves most often consumed in the afternoon or early evening. Plant biologists have also recognized that the processes of photosynthesis and plant metabolism result in nutrient compositions that cycle over a 24-hour period. This project seeks to fuse these observations, asking whether those foods consumed most preferentially at one time of day likewise exhibit the highest nutrient content at that particular time.

Two species of sapling commonly consumed within the Ngogo chimpanzee dietary niche (*Pterygota mildbraedii* and *Celtis africana*) were selected as particularly representative of those consumed most frequently in the afternoon and early evening. Young leaves were collected from 5 individual trees of each species at dawn, midday, and dusk towards the end of the dry season in late-July and early-August. It was expected that concentrations of carbohydrate and protein should increase throughout the day as products of photosynthesis and resultant downstream anabolic processes.

Nutrient analyses revealed increasing sugar content among *Celtis africana* saplings and decreasing fiber fractions among *Pterygota mildbraedii* across the photoperiod. Both nutrient trends represent increasing nutritional value over the course of the day, which is consistent with increased consumption among the Ngogo chimpanzees. This study represents the first such evidence linking chimpanzee consumption with diurnal nutrient variability. These results suggest that future foraging studies should consider the impact of temporal variation on food quality and choice.

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A phenetic analysis of the cranium of *Australopithecus sediba*.

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A preliminary phenetic analysis of the *Australopithecus sediba* cranium, UW88-50, was conducted to assess the nature and degree of phenetic affinity between *A. sediba* and other australopithecids and early *Homo*. The dataset was comprised of 10 craniofacial measurements taken from 16 hominin crania preserving relatively intact facial skeletons. The dataset was analyzed using principal components, discriminant function, and Euclidean distance matrix analyses. Analysis of the raw data revealed several clusters of specimens that broadly conform to taxonomic groupings. The three 'robust' australopithecid taxa form one cluster along the first principal component (53.2% of variance). *A. africanus* forms another grouping along the first principal component, while KNM-ER 1470 groups with a cluster of *H. erectus* specimens. UW88-50 plots most closely to SK847 and KNM-ER 1813 along the first principal component, with all three plotting in between the groupings of *A. africanus* and *H. erectus* + KNM-ER 1470. When the data are size-standardized, UW88-50 clusters closely with early *Homo* specimens along the first and second principal components (96.2% of variance), with groupings of *A. africanus* and the 'robust' australopithecids forming additional clusters. In both the raw- and size-standardized data analyses, Stw53 and OH24 grouped most closely with specimens of *A. africanus*, suggesting that these two specimens do not share their closest morphological affinities with *Homo*. The cranium of *A. sediba* possesses substantial morphological affinities with specimens currently classified as *Homo*, though we would caution that taxonomic diagnoses based on isolated skeletal regions require additional supporting evidence from other regions of the body.

Modeling joint loads in bipedal and quadrupedal marsupials and primates: insight into the uniqueness of modern humans.

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Recent comparative studies of subchondral bone in primate distal radii and distal tibiae suggest unique loading patterns in humans relative to other primates. Following

theoretical expectations, human distal radii (radiocarpal joints) appear to experience the least amount of weight-bearing (compressive) loads compared to the same joints of quadrupedal and suspensory primates. Contrary to theoretical expectations, however, human distal tibiae (talocrural joints) do not appear to experience more weight-bearing (compressive) loads compared to these joints in quadrupedal and suspensory primates. This is surprising given the different distribution of weight support by hind limbs during bipedal versus quadrupedal gaits. The aim of this study is to characterize analogous measures of weight-bearing (compressive) loads in subchondral bone of distal radii and tibiae of habitual bipedal and quadrupedal Australian marsupials. Specifically, we address whether radiodensity patterns of bipedal marsupials differ from those of quadrupedal marsupials, and if so, whether they differ in the same manner or a different manner than those of primates exhibiting the same gait characterizations.

We acquired image data from the distal radii and tibiae of marsupial bipeds (kangaroos), terrestrial quadrupeds (e.g., Tasmanian devils, wombats), and arboreal quadrupeds (koalas, possums), using computed tomography and following published protocols. From image stacks, we created maximum intensity projection maps (MIPs) that were color-coded and binned into eight groups. We compare distributions of relative maximum radiodensities within and across marsupial joint surfaces. Uniqueness of the human signal is discussed in the context of the comparisons of analogous primate and marsupial models for weight-bearing (compressive) loads.

This work is based upon research supported through the African Origins Platform of the Department of Science and Technology (South Africa), the National Research Foundation (South Africa), and the University of the Witwatersrand.

Alternative energy: modeling the effects of processed diets on human energy metabolism.

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Extensive dietary processing is a unique and universal human trait with potentially significant consequences for past and present energy metabolism. However the energetic effects of food processing can be difficult to study in humans due to the high degree of experimental control required and concerns related to the consumption of unprocessed foods. We have thus employed animal models in the pursuit of such questions. Our model-based research has previously demonstrated that the adoption of food processing technologies would have been energetically significant events, with non-thermal processing improving starch-rich plant foods, and cooking improving both meat and starch-rich plant foods regardless of prior processing by non-thermal methods. To better understand the mechanisms responsible for the increased energetic potential of processed diets, we have again turned to animal models to test the hypothesis that cooking and non-thermal processing reduce diet-induced thermogenesis,

the metabolic cost of digestion. In a collaborative study of pythons fed meat diets, cooking and non-thermal processing each lowered diet-induced thermogenesis by 12%, and their combined effects were nearly additive, with cooked/ground diets generating 23% less thermogenesis than raw/whole diets. A recent replication of this study among rats fed meat and tubers served raw/whole, raw/pounded, cooked/whole and cooked/pounded confirms that food processing reduces the thermogenic response, controlling for meal size and the metabolic contributions of activity. Implications for modern human nutrition and the evolution of human energy budgets are discussed.

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A combined molecular/morphological analysis of colobine interrelationships and the phylogenetic position of *Paracolobus*.

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The phylogenetic history of the Colobinae has been debated for decades and, despite advances in molecular phylogenetics, no classifications above the genus level are currently recognized within this subfamily. Furthermore, parsimony analyses of colobine phylogeny based on morphology are rare, leading to difficulties in discerning the relationships of fossil colobines. *Paracolobus* is a particularly enigmatic, large-bodied fossil colobine from the Plio-Pleistocene of Kenya. Though geographically an "African colobine" its links to the living colobus monkeys have yet to be tested within a strictly cladistic framework. To assess the phylogenetic position of *P. chemeroni* among extant colobines, molecular and morphological data were combined in the first total evidence analysis of the group. A total of 80 nuclear and mitochondrial gene sequences were collected (~81 kb) and 85 craniodental characters were scored for all ten colobine genera, eight outgroup taxa, and two fossil taxa. Most of the craniodental characters were quantitative, gap-coded, and treated as ordered.

Equally-weighted parsimony analysis of the combined dataset supports the monophyly of African and Asian colobines, and places *Paracolobus* within the African colobine clade as the sister taxon of *Colobus*. This result is consistent with phylogenetic hypotheses posited by previous researchers. Middle Miocene *Victoriapithecus macinnesi* is placed as the sister group to living cercopithecoids. Future studies will expand this matrix by adding other DNA sequences, postcranial characters, and a number of fossil colobines from Africa, Europe, and Asia in an effort to understand the evolutionary and biogeographic history of this subfamily.

This research was supported by Stony Brook University and Turkana Basin Institute.

Examination of female dyadic relationships in flexible social grouping of captive orangutans.

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The semi-solitary disposition of wild orangutans has not only set them apart socially from all other great apes, but has also greatly impacted captive care methods. In this study, we investigate the effect that a captive environment has on the social behaviors of orangutans. Behavioral observations were collected on four female captive orangutans at the Smithsonian National Zoological Park, in Washington, DC. These females were housed in various flexible social groupings, which also included two adult males. Our aim was to establish how much time female orangutans were spending with cohorts, as well as, what behaviors they were engaging in during this time. We found that, consistent with data collected in the wild, female orangutans spend a significant amount of time alone. When choosing to spend time with a conspecific, females preferred the company of other females, over males. In a captive environment where, inherently, there is great social opportunity, orangutans exhibit many social behaviors that are frequently seen in group-living apes. Our results showed that while equivalent levels of social behavior were observed among subjects in all groups, there was great variability among the specific behaviors exhibited depending on the group structure.

To gain a better understanding of common orangutan management strategies, we distributed a survey to all AZA institutions housing orangutans. Responses showed that there is great variation in social management between facilities, though minimal flexibility in group composition. Results from this study suggest that such flexibility can provide orangutans an opportunity for greater variance in social behavior.

The musculoskeletal system of humans is not tuned to maximize the economy of locomotion.

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Humans are known to have energetically optimal walking and running speeds at which the cost to travel a given distance is minimized. We hypothesized that "optimal" walking and running speeds would also exist at the level of individual locomotor muscles. Additionally, because humans are 60 to 70% more economical when they walk than when they run, we predicted that the different muscles would exhibit a greater degree of tuning to the energetically "optimal" speed during walking than during running. To test these hypotheses, we used electromyography to measure the activity of 13 muscles of the back and legs over a range of walking and running speeds in human subjects and calculated the cumulative activity required from each muscle to traverse a kilometer. We found that activity of each of these muscles was minimized at specific

walking and running speeds but the different muscles were not tuned to a particular speed in either gait. Although humans are clearly highly specialized for terrestrial locomotion compared to other great apes, the results of this study indicate that our locomotor muscles are not tuned to specific walking or running speeds and, therefore, do not maximize the economy of locomotion. This pattern may have evolved in response to selection to broaden the range of sustainable running speeds, to improve performance in motor behaviors not related to endurance locomotion or in response to selection for both.

Human fat deposition and upright posture.

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In well-nourished human beings, around 80% of body fat is subcutaneous, with percentages being generally higher in females. In most quadrupedal mammals, subcutaneous fat bodies are much smaller (4% to 30% of total body fat) and scattered. The great majority of body fat in quadrupeds is concentrated in omental and perirenal depots, where its weight is suspended directly from the vertebral column, whereas human omental fat is largely supported from below by the lower body wall and pelvic diaphragm. We suggest that the general transfer of fat deposition in humans from visceral to subcutaneous sites, including specialized cutaneous fat depots in the breasts, buttocks, and proximal limb segments, helps alleviate the increase in caudal intra-abdominal pressure (and correlated increase in the risk of herniation and visceral prolapse) brought about by a shift to exclusively vertical posture. The reduced incidence of inguinal hernias observed in obese males indicates that abdominal cutaneous fat may also help directly to support the abdominal body wall. The proliferation of subcutaneous fat in humans may have evolved as a corollary of the adoption of upright gaits and postures in Pliocene hominins.

The intercondylar notch as a tool in identifying sex.

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The development of an accurate biological profile is a central goal for anthropologists analyzing skeletal human remains. Specifically, the correct assessment of sex is an integral part of the profile. While many of the methods used to differentiate sex focus on features and measurements of the pelvis and skull, the measurement of other bones (i.e., the humerus, femur, and other long bones), have been found capable of distinguishing between males and females.

The current project focused on viability of using the maximum height of the intercondylar notch (MNH) at the distal end of the femur to separate males and females. This method is based upon the measurement proposed

by Baker (1988) and Baker et al. (1990) to determine ancestry in American Blacks and Whites and consisted of a single measurement. The mean MNH for each sex was used to create a sectioning point to separate males and females. The distribution of males and females around the point was examined.

A total of 1,971 individuals (1,123 males and 848 females) were measured representing six broad ancestry groups. When all of the groups were condensed 67% of males exhibited a MNH greater than or equal to the sectioning point and 65% of the females had MNH less than or equal to the sectioning point. When each ancestry group was examined separately the percentage of correct classification increased for most of the samples. The results suggest that this method exhibits promise as a tool in identifying sex in skeletal remains.

Carrying loads using bamboo poles: a potential method for reducing the metabolic cost of carrying.

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The ability to carry objects has played an important role in human evolution, from holding infants to transporting tools and other resources. Modern humans use a variety of carrying strategies and technologies, but differences in the metabolic costs of these methods are not well understood. It remains unclear which carrying methods are most economical and how human ancestors might have used them.

One simple technology for reducing energetic costs is to employ carrying structures that absorb, store, and return elastic energy. Throughout Asia springy bamboo poles are commonly used to balance loads across the shoulder. This study develops and tests a model for how poles may permit humans to carry heavy objects with great economy.

We examined this question under controlled lab conditions with Western subjects and in the field in Sichuan, China with porters who habitually use this technique. We show that the pole system can be modeled as a driven harmonic oscillator, allowing us to calculate the optimal relationship between step frequency and the natural frequency of the pole. This produces a stable, out-of-phase relationship between the vertical motion of the center of mass of the load and body. Predicted versus observed results suggest that people tune the pole and their gait to reduce metabolic costs compared to conventional carrying strategies. Preliminary data from China support the hypothesis that people may choose poles or modify their gaits to achieve a cost-saving phase relationship. These results are used to estimate energetic savings in hunter-gathers who also use carrying poles.

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Working our fingers to the bone: osteoarthritis in the hands of a historic population.

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This study examines osteoarthritis (OA) progression in the hands of an urban working class African-American and European-American population born during the 19th century. A total of 816 hands representing 408 individuals from the Hamann-Todd anatomical collection were macroscopically examined for evidence of OA. Using a nonrandom multi-stage sampling strategy, equal numbers of specimens were selected from each demographic subgroup: African-American males, African-American females, European-American males, and European-American females. Among these individuals, 206 were female and 202 were male while 202 were African-American and 206 were European-American.

Individuals were grouped into cohorts by age, birth year, sex and ethnicity and frequency differences were assessed using Fisher's exact test. OA was discovered in 44% of the sample with European-Americans (104/206) having significantly higher rates ($p = 0.0052$) than African-Americans (74/202). Additionally, individuals born after 1860 had significantly higher OA rates ($p = 0.0001$) compared to those born prior to that year. Archival research utilizing the Minnesota Population Center's Integrated Public Use Microdata Series (IPUMS) was used to help contextualize these results with regard to occupational stress from the antebellum period to the second industrial revolution in Cleveland, Ohio. As these results demonstrate, industrialism took its toll on the American work force as they toiled in factories and mills in an ever advancing industrial age.

Craniofacial differences between modern and archaeological Northeastern Thai skeletal populations.

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This biological distance analysis study's principal objective was to understand how environmental factors influenced cranial shape and size in Thai populations. Crania have been shown to change over time due to environmental influences. Craniometric data were employed to assess the differences between archaeological and modern populations, as cranial measurements have been demonstrated to be a useful proxy for genetic data and to understand epigenetic factors affecting crania.

Archaeological and modern Thai skeletal populations were utilized for this biological distance analysis. Both Thai populations were from the northeastern Thailand Isaan region. The archaeological Thai population from Ban Chiang is dated from the Pre-metal to Iron Age periods (2000 B.C.-200 A.D.). The modern Thai population dates from 1970s until present day. Cranial measurements were collected from 29 anthropologically accepted measurements to explore epigenetic and biological relationships between modern and archaeological populations.

Data were subjected to multiple multivariate statistical tests to determine

biological distance between the populations. The results from this study suggest that modern and archaeological Thai populations have markedly different crania, especially in shape. Ban Chiang individuals and modern Thai individuals are very biologically distant from each other, indicating that this archaeological population is not ancestral to the modern Thai population. Environmental factors may have likely played a large role in altering cranial shape in addition to unknown genetic and historical forces. This research may contribute to discussions of how epigenetic factors have influenced the crania and possibly suggest origins of modern Thai people.

A potential Late Pleistocene human skeleton in Hoyo Negro, a submerged cave site in Quintana Roo, Mexico.

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Human remains found in the submerged cave systems of the Yucatan Peninsula are providing a unique opportunity for Paleoindian research. One such skeleton lies in Hoyo Negro, a 60-meter deep pit at the end of a submerged tunnel of the Aktun Hu Cave System. In 2007 and 2010 cave explorers also discovered fire pits in the tunnel floor, rope marks in the pit rim, and a proboscidian skeleton only a few meters from the human. The below-sea-level elevation of the tunnel floor, fact that the pit is 180 meters upstream of the nearest opening, and similar condition of human and proboscidian remains indicate the skeletons may both date to the late Pleistocene.

Inspection of underwater videos and high-resolution still photographs has been conducted to inventory and assess the human skeleton, which includes a complete cranium and mandible, vertebrae, ribs, one os coxae, and the longbones of both arms, in exceptional condition. They represent a female that third-molar development, recent epiphyseal union in the humerus, and lack of fusion in the basilar suture and iliac crest show died at between 16 and 18 years. The un-deformed cranium exhibits the relatively elongated neurocranium, narrow, projecting upper face and prognathism common in Paleoamerican females. Minimally worn teeth show a mix of traits found in other Paleoamericans.

Continuing research by an INAH-affiliated interdisciplinary team includes minimal sampling and noninvasive in-situ two and three-dimensional imaging to date the remains and provide additional osteological, morphometric, and genetic data for comparison with other early Americans.

This research was conducted under the auspices of the Subdireccion de Arqueologia Subacuatica of INAH.

Systematics of Paleocene-Eocene micromomyid plesiadapiforms.

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Recent studies suggest that micromomyid plesiadapiforms are among the most primitive stem primates. Unlike other primitive plesiadapiforms that are known only from fragmentary dentitions, such as *Purgatorius*, micromomyids are known from complete dentitions, partial crania, and elements of the postcranium. Micromomyids are small-bodied (15-50g) arborealists represented by at least ten species that span approximately five million years, overlapping with the first appearance of euprimates. Though several new taxa have recently been described, questions concerning interrelationships among micromomyids have received little treatment over the last two decades. Here we report new fossils of late Paleocene and early Eocene micromomyids recovered from freshwater limestones of the Clarks Fork Basin, Wyoming, that include previously unknown tooth positions of *Chalicomomys antelucanus*, an isolated tooth of *Dryomomys*, and the earliest occurrence and first substantial Paleocene sample (n=23) of *Tinimomys graybulliensis*. A new cladistic analysis of dental and gnathic characteristics (n=28) for all known micromomyid species resulted in a fairly well resolved hypothesis of relationships, strongly suggesting that most species previously classified in the genus *Micromomys* do not form a natural grouping. Specifically, a basal clade is recovered including *Micromomys fremdi*, whereas the type species, *M. silvercouleii*, is more closely related to other micromomyid species. Early Eocene *C. antelucanus* is quite primitive, which implies a fairly long ghost lineage. The *Dryomomys* and *Tinimomys* clades, which are uniquely derived in possessing relatively large premolars and more bunodont molar cusps, respectively, appear to have diverged from more basal micromomyids during or before the late Paleocene.

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Osteoarthritis as a means to reassociate commingled skeletal remains.

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Commingled mortuary contexts contribute a great deal to the study of populations. However, challenges in reassociating skeletal remains often prohibit researchers from gathering information from these sites. To rectify this, there is a need to study and develop methods in order to facilitate the reassociation of discrete individuals. Osteoarthritis was used in this study to determine if the methods of pair matching and articulation can reliably be applied to commingling by

investigating whether the presence and severity of osteoarthritis is consistent.

In order to perform this research, an analysis of 85 complete joint surfaces was performed using the Orendorf skeletal sample. A correlation was found between the presence of osteoarthritis in the ulna and humerus ($\chi^2 = 7.374$ for 2 df, $p = 0.025$) and between all of the bones of the shoulder ($\chi^2 = 12.857$ for 1 df, $p = 0.000$), hip ($\chi^2 = 26.466$ for 4 df, $p = 0.000$), and knee ($\chi^2 = 10.459$ for 2 df, $p = 0.005$). However, no correlation was found between the radius and humerus in the elbow ($\chi^2 = 1.345$ for 2 df, $p = 0.510$). These results led to the conclusion that the severity and presence of osteoarthritis should be consistent across joint surfaces. The results of this study, as well as future directions of this research, have relevance to both bioarchaeology and forensic anthropology, as both subdisciplines investigate mass burial contexts.

Trabecular density in cursorial and non-cursorial limb joints.

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Skeletal design among cursorial animals is a compromise between a stable body that can withstand locomotor stress and a light design that is energetically inexpensive to grow, maintain and move. It has been hypothesized that to maintain a balance between safety and energetic cost, cursors have reduced distal musculoskeletal mass. This is due to an exponential increase in energetic demand during oscillation of the distal limb. Experimental research shows that cortical bone in distal limbs experiences higher strains and remodeling rates, apparently maintaining lower mass at the expense of a smaller safety factor. Here, we test the hypothesis that cursors have lower trabecular density in distal relative to proximal limb joints, in order to minimize energetic cost. We use pQCT scanning to measure trabecular density in the lower and upper limbs of humans, chimpanzees, cheetahs and mountain lions.

Our results show that cheetahs exhibit significantly denser trabecular bone in femoral heads than in third metatarsal heads. This result supports the hypothesis that there is proximo-distal reduction in trabecular density among cursorial sprinters. However, chimpanzees (non-cursors) exhibit a similar pattern with denser femoral heads than MT3 heads. Thirdly, contrary to the proximo-distal reduction hypothesis, the upper limbs of cursors (cheetahs-sprinters, mountain lions-distance travellers) and non-cursors (chimpanzees), as well as humans, all exhibit denser third metacarpal heads than humeral heads. These results suggest an overall trend with an increase in trabecular density in the distal elements of the upper limb in both cursors and non-cursors.

Dental microwear texture analysis of Bronze and Iron Age Agriculturalists from England.

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Archaeological evidence indicates that agriculture became an increasingly important subsistence strategy in England from the Early Bronze Age (EBA, ~2500-1500 BC) to the Middle/Late Bronze Age (MLBA, ~1500-800 BC) and Iron Age (IA, ~800 BC-100 AD). Through time, people exploited more land for farming, planted hulled barley over naked barley, and spelt over emmer wheat. Other new foods included rye and Celtic bean. Evidence for food processing is sparse, but cereals appear to have been ground using stone tools. Here, we reconstruct diet through dental texture analysis and compare results to the subsistence data from archaeological sources.

Using a white-light confocal profiler and scale-sensitive fractal analysis software, we compared anisotropy (epLsar), complexity (Asfc), and textural fill volume (Tfv) of upper and lower first and second molars of EBA (n=32), MLBA (n=11), and IA (n=7) individuals from England. One-way ANOVAs indicate that epLsar (0.00424566, 0.00490245, and 0.00398671, respectively) and Tfv (32193.0053, 38098.9734, and 36637.3455, respectively) did not differ significantly. However, Asfc decreased significantly (1.424062, 1.239129, and 1.135811, respectively) from the EBA to the MLBA, and from the MLBA to the IA (df=2, F=11.772, $p < 0.000$). The decrease in complexity suggests that the diet became significantly softer. However, the similarity in the epLsar and Tfv values when compared between the time periods indicate that the dietary shift was not a wholesale change. Rather, relatively few changes in diet occurred over time even as the variety of foods available increased.

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Who left Africa first? A multivariate analysis of the Dmanisi crania.

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The evaluation of the morphological affinities of the first hominins to leave Africa is of critical importance to the clarification of the routes and patterns of the first dispersal events. The Dmanisi site has the potential to answer questions as to the timing and basis of the initial dispersal of hominins outside of Africa. The morphological affinities of the Dmanisi hominins (D2280, 2282 and 2700) were examined using discriminant function analysis (DFA) with published cranial measurements. The Dmanisi crania have been suggested to share morphological features with *Homo habilis sensu lato* as well as African and Asian *H. erectus* because of this the comparative sample chosen

consisted of hominin crania which are commonly attributed to early *Homo*, including *H. habilis sensu lato*, *H. habilis sensu stricto*, *H. rudolfensis*, *H. erectus s. l.*, *H. erectus s. s.* and *H. ergaster*.

Since DFA was used, the predefined classification of the comparative sample governed the classification of the Dmanisi hominins. Therefore, 4 models of commonly proposed early *Homo* phylogeny were utilized. The results indicate that the Dmanisi hominins appear to be quite variable; in fact, to such a degree that different analyses resulted in differing taxonomic affinities. The resulting inconsistencies in taxonomic classification in this study suggest that the Dmanisi hominins may not fit in smoothly with existing hypodigms. The findings of this study are consistent with those of other researchers and suggest that the Dmanisi hominins may represent a group near the stem of the *Homo* clade.

Climatic-volcanic framework for early hominin endemism on Sunda.

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Homo erectus colonized the emergent Eurasian Pleistocene landmass, Sunda, before 1.5 Ma, and underwent an adaptive radiation across subsequent regional oscillations and events. This research establishes a climate- and volcanism-based framework for Sunda *Homo erectus* diversification and endemism. Two major climatic cycling shifts anchor the sequence.

At MIS 23 (~0.9 Ma), the Mid-Pleistocene Revolution brought a significant change in climatic cycling, preserved at the Solo (Java), Soa (Flores), and Cagayan (Luzon) basins as major faunal turnover events (MIS 23-20). The Bose (Guangxi) evidence also lies within this time frame. Mid-Pleistocene Revolution events may have definitively isolated hominin groups, including Solo *Homo erectus*, emergent *Homo floresiensis*, and the species represented in Callao (Luzon, Philippines). After MIS 20, no evidence is known for several hundred thousand years, as the low-amplitude, evenly-phased 100-kyr climate cycles were not conducive to the preservation of open-air sites. Fortunately, at MIS 11 (~0.4 Ma), the Mid-Brunhes Event climate cycle changes may have hastened regional karst development. This in turn lead to sufficient cave development hospitable for early hominin living sites by MIS 9, as found at Gunung Sewu (Java) Liang Bua (Flores) and Cagayan (Luzon). These last sites yield most evidence for the later Lower Paleolithic sequence, except for local catastrophe-related open-air sites, such as Ngandong.

Following a diversifying run of at least 1.5 Ma, Sunda's *Homo erectus*-derived populations disappeared during the Late Pleistocene. The arrival of *Homo sapiens* was apparently not a factor. The extinctions may reflect insular endemism and local volcanic catastrophes during MIS 5-2.

This long-term project was funded by the L.S.B Leakey Foundation (4 grants), the Wenner Gren Foundation for Anthropological Research

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The relationship between strenuous physical activity and C-reactive protein is cycle-phase dependent: results from rural Poland.

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Energetic and inflammatory variables impact ovarian functioning, but their mechanistic links to each other and the ovaries remain unclear. We hypothesize that inflammatory biomarker C-reactive protein (CRP) is negatively correlated with strenuous physical activity in a population of rural Polish women. Because progesterone is suppressed by physical activity, yet progesterone administration can increase physical activity, we further hypothesized that their activity patterns would vary between the follicular and luteal phases, periods of low and high progesterone. Using standard epidemiological methods to collect daily records of minutes and exertion of physical activity over one menstrual cycle, we distinguished between light and strenuous activity, and activity variation through the cycle. Saliva was collected daily (progesterone), and urine seven times over the cycle (CRP).

Midluteal progesterone concentrations were inversely correlated with luteal CRP ($p = 0.02$), median CRP ($p = 0.05$), and were positively associated with strenuous activity in the luteal phase ($p = 0.09$). Median, luteal and follicular CRP were all negatively correlated with strenuous activity in the luteal phase ($p = 0.03$ for all three measures). And when women were grouped into those with high and low CRP concentrations, those with low CRP performed significantly more strenuous physical activity through the luteal phase. None of these associations were found with follicular phase physical activity. These results suggest physical activity influences systemic inflammation, which may additionally influence ovarian functioning. Therefore continued attention on systemic inflammation is crucial to determine mechanistic links between it and reproductive success in women.

This study was funded by the Yale Center for Human and Primate Reproductive Ecology and the University of Illinois Department of Anthropology.

Manual phalangeal curvature and its relationship to positional behavior in anthropoids.

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The presence of relatively long and curved manual phalanges in both extinct and extant anthropoid species has been used in the past as evidence of suspensory positional behavior. However, the relationships between phalangeal length, curvature, and positional

behavior are incompletely understood. Some models predict that both phalangeal length and body mass will have an effect on phalangeal curvature out of biomechanical necessity. A better understanding of these relationships can help us to reconstruct the positional behavior of extinct relatives, including the precursors of our unique bipedalism. Phalangeal measurements and body mass estimations were collected from a broad sample of living anthropoid species. As one would expect, phalangeal length is tightly correlated with body mass. Phalangeal curvature (degrees of arc) is strongly correlated with length across the entire sample, but more weakly within taxonomic groups. Curvature is weakly correlated with body mass across the entire sample, and individuals are tightly clustered based on positional behavior. Phalangeal curvature and body mass together are able to predict the dominant positional behavior of an individual with 80% accuracy. Intra-group variation in curvature is still unexplained, but there is evidence for an ontogenetic remodeling component to this trait that may reflect individual variations in behavior. The hand of the recently described *Ardipithecus ramidus*, interpreted as an above-branch walker, clusters with animals with a more significant degree of suspension.

Fecal bacterial diversity of the wild mantled howling monkey (*Alouatta palliata*).

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Mantled howling monkeys (*Alouatta palliata*) are New World Monkeys living in the Neotropics whose diet is primarily composed of foliage. In howlers, the primary sites of microbial fermentation are in the cecum and colon where a diverse group of microbes with cellulose-digesting abilities dwell. This digestive specialization is known as hindgut fermentation.

Commensal microbial communities play a key role in animal and human health, and the characterization of these populations is essential to understand divergent adaptations in closely related species. The emerging field of metagenomics combined with high throughput sequencing allows direct, unbiased interrogation of microbial populations, thus enabling the investigation of unique dietary differences in human and non-human primate species that may reveal the role of microbial communities in primate speciation. Here we present the first study of the structure of the intestinal bacterial community of the mantled howling monkey, using high-throughput sequencing and metagenomic analysis.

Our study showed that the fecal microbiome of the mantled howler was dominated by phyla Firmicutes (59.01%) with Bacteroidetes (13.81%), Unclassified (17.49%) and TM7 (3.61%) in lower concentrations. Compared to other non-human primate species examined in previous studies, the phylum TM7 comprised a much higher percentage of the fecal microbiome in mantled howling monkeys. This factor makes mantled howlers unique among

other non-human primates previously studied in regards to their gut microbial community structure.

This study was funded by the University of Minnesota College of Veterinary Medicine.

Why so worn? Tooth wear analysis of the Santa Barbara Channel area Chumash people.

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The dentitions of past groups of Chumash people from the Santa Barbara Channel area exhibit some of the most extreme patterns of tooth wear found within archaeological populations. They represent a complex group of hunter-gatherers who occupied this region of the world from approximately 13,000 B.P. and are associated with both a rich archaeological and skeletal and dental record. This allows comparisons to be made both geographically and temporally. The wear rate is calculated by measuring the dentine proportion (the area of exposed dentine relative to the area of the occlusal surface) of the first molars and second molars within each dentition. The dentine proportions of the second molars are then divided by the dentine proportions of the first molars to produce a rate of wear for each specimen. Wear rates are compared between specimens from early, middle and late periods and between island and coastal sites. The results of this study show that the rate of wear is extremely high for all groups, but decreases over time. No significant differences in wear rates are found between island and mainland populations. In addition, the lower dentitions show a higher rate of wear than their upper counterparts for all groups. The differences in these high rates of tooth wear are interpreted using the archaeological evidence for diet and craft activity.

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Developmental stress, reproductive development and adult body size: a life history perspective.

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Across human populations, women who reach sexual maturity at a younger age are consistently shorter, heavier and thus have a higher body mass index (BMI) than later maturing women. Higher levels of childhood psychosocial stress have been shown to accelerate age at sexual maturity in humans. To our knowledge, however, it has not been established whether the early psychosocial environment also has consequences for a woman's adult body size. We test the hypothesis that for women who experienced higher levels of childhood psychosocial stress, an earlier menarche will be associated with being shorter,

heavier and having a higher BMI in adulthood than women who experienced no childhood stressors. The data for this study came from 580 pregnant women who completed self-report questionnaires. The childhood psychosocial environment was measured via 10 stressful life events experienced before 15 years of age. In the full sample earlier maturing women were significantly heavier ($r = -.124$), shorter ($r = .137$) and had a higher BMI ($r = -.209$). These associations were not consistent across sub-groups however. As predicted, early menarche was only associated with being heavier and having a higher BMI in women who experienced higher levels of childhood psychosocial stress. Conversely, in women who experienced no childhood stressors, there was no association between menarche and weight or BMI. Interestingly, the positive association between menarche and height was consistent across groups. These findings suggest a woman's developmental environment moderates the negative association between her age at sexual maturity and her adult weight and BMI.

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Mandibular growth in *Australopithecus robustus*: a computational approach.

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Growth and development are the proximate mechanisms that result in adult form: as de Beer (1940: 98) put it, "phylogeny is but the result of modified ontogeny." Understanding the evolution of human growth and development can provide insight into how unique aspects of human morphology and life history evolved. For example, a childhood of slow skeletal growth followed by an adolescent growth spurt arguably reflect humans' cultural niche. But because fossil samples are small and fragmentary, it is difficult to tell when these traits evolved. Several studies have suggested that the relationship between skeletal and dental development – and therefore overall growth – in Pleistocene hominids was not like recent humans. These studies have been based on small fossil samples and rarely include a statistical test. Here I propose a resampling-based test of the hypothesis that the relationship between dental eruption and mandibular growth does not differ between cross-sectional samples of modern humans and *Australopithecus robustus*. Although *A. robustus* is not a direct human ancestor, its mandible has a relatively complete ontogenetic series, documenting variation within and across age groups from infant to adult. If the null hypothesis cannot be disproved for this sister taxon, there are implications for interpreting these variables in ancestral hominids. I discuss the relative merits of traditional statistics versus randomization-based methods for the study of growth in fossil samples, and suggest future avenues for understanding the evolution of human growth and development.

This research was supported by grants from the University of Michigan's International Institute and African Studies Center.

New research on the Colonial Period Maya Cemetery at Tipu, Belize.

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The Maya population from the visita mission cemetery at Tipu in western Belize offers insight into the colonial experience on the frontier of European contact. Its remote location allowed residents to negotiate Spanish control during existence of the church from 1541 until 1707. It also permitted maintenance of many precontact cultural traits, such as participation in established trade systems and retention of kin networks. The skeletal series of 550 individuals was excavated the 1980s, and previous studies concerning a variety of health markers, including growth arrest indicators and stature, suggest that the overall health status was quite good. Life expectancy was rather low, but this may result from service of Tipu as a refugee center.

Recent research on the series has re-evaluated several health indicators, such as hypoplasia and periostitis, using more current scoring standards, and has confirmed their generally low frequencies at Tipu compared to contemporaneous populations. Emerging technologies have also allowed investigation into new health and ancestry markers, including mtDNA and bone morphometrics. Other efforts have focused on spatial interpretation of the cemetery. An interactive 3-dimensional map has been created with ArcGIS that permits any demographic or health marker or combination thereof to be displayed. Recent fluorine analysis, which has demonstrated no temporal patterning of cemetery usage, will allow reanalysis of existing data for changes over time. It is anticipated that these new investigations will provide a more nuanced understanding of how location and other factors may have buffered the health of the Tipu Maya.

Relationships between skull size and body mass in primates.

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The primary goal of this project was to establish a skull size dataset for all primates and begin comparing aspects of these data with overall body size (mass). In order to estimate skull size, 28 skull dimensions were measured to the nearest 0.01mm and cranial and mandibular mass were weighed to the nearest 0.1g. These measurements attempt to capture all the major regions of the skull and were evaluated both individually and collectively by calculating a geometric mean of skull size. In total, over 3500 dry specimens were investigated representing every accessible species of primate (~ 250) from the collections at several major museums in the United States (AMNH, FMNH, USNM, MCZ). Body mass estimates were taken from the literature although body mass data were also

collected for individual museum specimens whenever these data were available.

Overall, there is a highly significant negative allometric relationship between body mass and the geometric mean of skull size. However, individual taxonomic groups demonstrate significant differences in relative skull size (skull size / body mass). For example, platyrrhines have relatively larger skulls than catarrhines, and tarsiers have the relatively largest skulls of any primate. Considering sexual dimorphism, patterns between body mass and skull size are highly correlated, although the degree of dimorphism is generally lower when evaluated using skull size compared to body mass. Individual cranial measurements were also evaluated for their ability to predict body mass, and the results were highly dependent on the taxonomic level used for the analysis (order, superfamily, etc.).

Funding to M.N.C. for museum travel was provided by Midwestern University.

Functional morphology of the fossil hominin tarsus: new findings using 3D laser surface scans.

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The foot is one of the most informative areas of the body when reconstructing the locomotion of extant hominoids and fossil hominins as inferred from skeletal remains. The functional relationships between the articular facets of the tarsals, particularly those of the "rearfoot" (the talus, navicular, calcaneus and cuboid) are central to understanding how weight is distributed through the foot to the substrate during locomotion. These relationships have many morphological components, including the angulation between facets, their individual surface morphology, and their relative size.

While studies of facet surface areas have traditionally used the product of simple linear measurements, such techniques do not reflect the often complex surface topologies. Using high resolution 3D laser surface scans of the talus, cuboid and navicular of gorillas (13), chimpanzees (18), modern humans (18) and fossil hominins (5), we were able to extract precise surface areas of the articular facets. For each element, individual surface areas were size-corrected using the total volume of that element. Surface areas were also compared to each other using ratios, which were then pooled and subjected to principal components analysis.

Results indicate that the size relationships between the articular facets of Plio-Pleistocene fossil hominins were mosaic, depending on the taxon. Of noticeable interest are the fossil hominin tali from Koobi Fora (1.7Ma), whose facet size ratios and size-adjusted values fall outside the range of modern human variation, indicating a unique weight distribution pattern through the upper and lower ankle joints.

A reassessment of the applicability of Bergmann's Rule to humans.

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It is widely accepted that human body size varies in accordance with Bergmann's Rule, which states that body mass within a species should increase with latitude and cooler temperatures. However, the studies supporting this hypothesis have used samples that include a disproportionately large number of warm-climate populations. Here, we investigated whether the finding that humans conform to Bergmann's Rule is an artifact of the use of warm climate-biased samples.

Data on adult male mass, stature, geographic location, and mean annual temperature were compiled for 265 populations. The sample was stratified to include four populations for each five degree band of latitude. Regression analysis was used to assess the direction and strength of the relationships between latitude and mean annual temperature on the one hand, and body mass, Body Mass Index (BMI), Ponderal Index (PI), and surface-area-to-body-mass ratio on the other.

When populations from north and south of the equator were analyzed together, Bergmann's Rule was supported. The anthropometric variables correlated significantly with latitude and mean annual temperature in the majority of analyses. However, when populations were separated by hemisphere, Bergmann's rule was not supported. In the northern latitude sample, the relationships between BMI, PI, and surface-area-to-body-mass ratio and mean annual temperature were quadratic rather than linear. In the southern latitude sample, none of the anthropometric variables was significantly correlated with latitude or mean annual temperature. These results suggest that it is only in northern latitudes that human body size variation conforms to Bergmann's rule.

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Blunt or sharp force trauma: differential diagnosis of a lesion on a Bronze Age skull from Uglemose, Denmark.

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The remains of several individuals, including two children and two adult males, were excavated from Uglemose (Owl Bog) outside of Birket, Denmark on the island of Lolland. Carbon-14 samples from one of the adult tibias places the find around 500 BC, the end of the Danish Bronze Age and transition period into the pre-Roman Iron Age (Kaul 2011). The skull of

one middle adult male demonstrates a traumatic ante-mortem lesion to the left maxilla, directly below the orbit, that opens into the maxillary sinus. The left margin of the injury is slightly rounded and angled into the lesion while the right margin is pulled out from the lesion and has a much sharper border, suggesting a directional force from left to right.

Previous assessment of the lesion suggested projectile trauma as a cause (Kaul 2011) but the lesion does not conclusively demonstrate features of sharp force trauma. CT scans and 3D visualization of the skull show no evidence of structural changes to the maxillary sinus to support a conclusion of projectile trauma. Differential diagnosis through macroscopic and microscopic analysis of the lesion would suggest blunt force trauma rather than sharp force. The potential mechanisms of injury and cultural factors associated with interpersonal violence in Bronze Age Denmark will be discussed.

Diet reconstruction in prehistoric Rapa Nui and its implications for models of resource depletion.

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Previous research on Rapa Nui suggests that by AD 1650 the island experienced a dramatic reduction in available resources due to overexploitation. Various proponents argue that this reduction resulted in cultural fragmentation and decline by the time of European contact. While some archaeological and historic accounts support this model, we do not yet know the true magnitude of impact this resource shift had on the prehistoric population. We attempt to address this through the use of stable carbon and nitrogen isotopes in human tooth dentin, with the ultimate goal of identifying attendant shifts in prehistoric Rapanui diet. We initially extracted collagen from 8 samples for analysis. The mean values for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ ranged between -16.67 to -19.15‰ and 12.50 to 17.05‰, respectively, with an apparent bimodal distribution ($\delta^{13}\text{C}$ 2-tailed t-test: $p=0.002$; $\delta^{15}\text{N}$ 2-tailed t-test: $p<0.000$) indicative of dietary differences between individuals. Comparison to published isotope values of marine and terrestrial fauna in the Pacific suggests a diet focused on terrestrial animals (chicken and possibly rat), C_3 plants and near shore marine resources, with little input from higher trophic levels (e.g., pelagic fish). To evaluate this further, we analyzed 20 additional samples for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in collagen, all samples ($n=28$) for $\delta^{13}\text{C}$ in bone apatite, and a sample of faunal material recovered from archaeological contexts to obtain a more accurate estimation of the Rapa Nui food web. The results of these analyses are discussed in terms of the social and physical geography of the island.

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***Australopithecus afarensis* mandible with supernumerary molars from the Hadar site, Ethiopia.**

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Supernumerary molars (M4) are an uncommon variant of hyperdontia in primates. Estimates of M4 frequencies in nonhuman anthropoid samples typically range from 0-4% but to greater than 10% in some large-bodied hominoids (e.g., *Pongo*). In humans the etiology of supernumerary molars remains an open question in non-syndromic cases, in which the most common form of hyperdontia involves multiple occurrences of extra successional teeth, the incisors or premolars.

A.L. 1901-1 is a fragmented mandibular corpus diagnostic of *Australopithecus afarensis* from Hadar, Ethiopia. The specimen was found on an exposed surface of DD-3 submember sediments of the Hadar Formation and is 3.20 to 3.24 million years old. It retains most of the tooth crowns or roots, and though many of the crowns are heavily eroded or broken, bilateral supernumerary M4s are present as distomolars. The M4s are asymmetrically developed; the left is a fully formed "normal" crown, whereas the right is peg-shaped. Eruption of the left tooth caused severe crowding and rotation of the ipsilateral M3. No such rotation is observed on the right side.

Within the Hadar sample of *A. afarensis* mandibles containing a complete molar row, 2 out of 21 (9.5%) specimens hold supernumerary M4s. Although the sample size is modest, this frequency is consistent with those reported for large-bodied extant hominoids. Given that both Hadar mandibles bear supernumerary teeth in the most posterior (non-successional) portion of an otherwise normal-appearing tooth row, they are more likely due to anomalous hyperactivity of the dental lamina than to some undiagnosed genetic syndrome.

Dental fracture mechanics and the reconstruction of hominin bite forces.

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Tooth enamel is a hard substance that does not deform easily under load. However, it is also brittle and susceptible to fracture. Previous work has shown that such fractures can be used as a diagnostic tool for reconstructing bite forces in mammals with bunodont dentitions. Through simulated biting experiments on model tooth structures and extracted human molars, three principal fracture modes in enamel – radial-median cracks, margin cracks, and chipping – have been identified. Fracture mechanics theory from materials science allows one to derive explicit relations for quantifying critical bite forces from each crack type in terms of characteristic tooth size and enamel thickness. We used 2D and 3D computed tomography to determine enamel thickness and tooth size in a

series of fossil hominin lower molars from both East and southern Africa, and then used these data to calculate and compare bite forces among those hominins. The results show that the "robust" australopiths were capable of very high bite forces, in the range of 2000 N, but even the more gracile australopiths had bite forces in the range of extant great apes and considerably higher than those of modern humans.

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La fin du voyage: the French Colonial experience in the Americas.

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Among the major European powers that colonized the Americas, the French experience is perhaps the least represented within the bioarchaeological record. Among the handful of sites with human remains present are St. Croix Island in Maine, which dates to 1604 and is composed of sailors (N=25); Fort Michillimackinac (1715-1781) in Michigan, which was a frontier military installation (N=15), and St. Peter's Cemetery in New Orleans (1725-1785), which is composed of residents of an established community (N=29). A fourth, the Moran site (1717-1722) in Biloxi, Mississippi, contains the remains of immigrants who died at a short-term staging center as they awaited transport to concessions inland. The series, composed of 31 primary burials, is almost exclusively young adult males with only two adult females and scattered juvenile elements. Ancestral evaluation suggests most are European, but some may exhibit mixed ancestry. Although certain pathologies, including periosteal lesions and porotic hyperostosis, are infrequent, most individuals display short stature and high rates of growth arrest markers. They also exhibited well developed muscle markings. Overall, these findings closely correlate with expectations based on the ethnohistoric record depicting social outcasts dying of infectious disease and malnutrition soon after arrival. When these results compared to those of other French colonial sites, a large degree of variability in health profiles is seen, reflecting cultural and biological adaptation to local circumstances. This contrasts with the arguably more homogeneous mission experience of the Spanish and warring expansion of the British.

Pretos Novos: in search for signs of adult scurvy in the slave trade to Brazil, 1769-1830. D.C. Cook, Indiana University¹.

DELLA C. COOK. Anthropology, Indiana University.

Adult scurvy produces distinct skeletal signs from those seen in infancy or early childhood. Its strong association with sea travel is a prominent feature of historical accounts. The rigors of the transatlantic slave trade to Brazil were associated with reported outbreaks of

scurvy on board many ships. Some historians question these accounts because skin diseases may mimic scurvy and because the time spent in passage was short. Evidence for the provisioning of slave ships is limited,

There have been several experimental studies on adult scurvy in humans. A review shows that vitamin C free diets produce anemia, gingival bleeding and tooth loss within as little as 90 days. Bone loss, bone pain and subperiosteal hemorrhage are later consequences. Fascial and periosteal new bone formation should be expected only in healing scurvy. Adolescents might show more periosteal new bone formation reflecting bone growth.

Cemiterio Pretos Novos in Rio de Janeiro, Brazil, was a burial place for newly arrived slaves who survived the passage but died before being sold. Remains are limited to an accidental discovery during renovations in a residential area built over the cemetery. Teeth and jaws representing 34 persons were recovered. Most were adolescents or young adults, as is expected in newly enslaved Africans. Oral health was excellent. Periodontal pockets, excessive periodontal bone loss, tooth loss, and new bone formation attributable to scurvy were not observed. This surprising result is examined in the light of historical accounts of shipboard morbidity and mortality.

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Dental morphology and dietary adaptation in *Homunculus patagonicus*.

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Homunculus patagonicus, from the Miocene of Patagonia, is part of the southernmost limit of the platyrrhine radiation. While paleoecological reconstructions of Miocene Patagonia suggest a warmer environment than is present today, there would have been significant seasonality, perhaps requiring dietary flexibility throughout the year. To better understand the dental adaptations of *Homunculus*, our study uses three-dimensional geometric morphometrics to examine molar morphology. The maxillary and mandibular first and second molars of a sample of platyrrhine primates (n>250) were laser scanned to create three-dimensional models. Twenty-three x, y, z coordinate landmarks were applied to each tooth to outline major morphological features such as crests, cusp tips, and basins. Principal components analysis (PCA) was then performed on generalized Procrustes analysis - aligned landmarks. For lower molars, PC1 was largely driven by cusp and crown height and was found to successfully differentiate primates of different dietary categories using discriminant function analysis (DFA). PCA of upper molar landmarks was less successful at differentiating primates by diet, and PC1 was largely driven by relative cusp position rather than cusp and crown height. Additionally, there appears to be more of a phylogenetic component to the morphology of the upper molars. *Homunculus* showed a moderate degree of dental relief on the lower molars – in the range of *Aotus* or *Callicebus*

amongst the modern taxa. For upper molar morphology, it also fell within the range of these species. DFA classifies *Homunculus* with the frugivorous primates, but it falls within the range of the less committed frugivores *Aotus* and *Callicebus*.

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Tracking ancient animal movements in northern Tanzania using strontium isotopes.

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In this study we sought to determine 1) whether biologically available ⁸⁷Sr/⁸⁶Sr varies across northern Tanzania in the vicinity of Olduvai Gorge and Laetoli, and 2) whether fossil fauna from Olduvai Gorge potentially reflect these differences and indicate landscape movement. Strontium isotope (⁸⁷Sr/⁸⁶Sr) composition of tooth enamel originates from the underlying bedrock, depends on the rock's age and original composition, and is passed into soils, plants, and animals that eat the plants in each region. In order to determine biologically available Sr isotope ratios, we measured ⁸⁷Sr/⁸⁶Sr from modern owl-roost rodents collected from Serengeti and Manyara National Parks in Tanzania. Results indicate that biologically available ⁸⁷Sr/⁸⁶Sr is higher in northern and western Serengeti National Park (~0.707-0.719) than in the eastern Serengeti plains (~0.704-0.706). This is potentially explained by differences in geology, as Precambrian bedrock underlies parts of northern and western Serengeti, while the substrate of the eastern Serengeti plains derives from recent volcanic eruptions. A pilot study of strontium isotope ratios in fossil fauna from Olduvai Upper Bed I and Lowermost Bed II shows evidence against post-depositional alteration of ⁸⁷Sr/⁸⁶Sr, and indicates that some bovids may have obtained their food within the local vicinity. However, a proboscidian specimen from VEK has a higher ⁸⁷Sr/⁸⁶Sr consistent with it having ranged in areas of northern Serengeti, western Serengeti, or elsewhere during its youth. These results suggest that strontium isotopes may prove to be a useful method for investigating land use patterns in ancient fauna and hominins from northern Tanzania.

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Rodents and monkeys and apes, Oh my: comparative and experimental investigations of systemic skeletal robusticity in rodents and primates.

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Increased cranial vault thickness in *Homo erectus* and some *Homo heidelbergensis* is an intractable paleoanthropological conundrum that has proved resistant to explanation for over 100 years. One hypothesized mechanism, systemic skeletal robusticity mediated by exercise-induced growth factors, has never been rigorously tested. We present data from 4 experiments involving mice or rats that directly tested the relationships among locomotor activity, circulating growth hormones, and systemic skeletal robusticity. In no group was circulating IGF-I, IGFBP-3, or their ratio significantly associated with measures of skeletal robusticity. Some measures of femoral and humeral robusticity were correlated with some measures of cranial vault thickness in some groups – offering limited, but intriguing support for the hypothesis. For example, in the rat study, total cortical thickness of the parietal bone was weakly correlated with femoral cortical : total area ratio ($r=0.375$, $p=0.025$), but total parietal thickness was not statistically associated with any measure of postcranial robusticity.

Systemic robusticity was also examined in modern humans, *Trachypithecus cristatus*, and *Hylobates lar*. No hormone information was available, but measures of cranial and postcranial robusticity were not significantly correlated in any species.

Our projects demonstrate that model organisms can prove useful in addressing classic questions of paleoanthropological interest. Comparative primate morphology alone could not have fully and rigorously tested the hypothesis. These studies are the first to integrate data from multiple animal models investigated in controlled experimental settings. Together, they suggest that activity-mediated hormonal control of systemic robusticity remains an intriguing, but incomplete, explanation for Pleistocene cranial hyperostosis.

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Dominance in male mantled howlers (*Alouatta palliata*): association with age, immigration patterns and group history in two social groups at Hacienda La Pacifica, Costa Rica.

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Mantled howler males at La Pacifica have been described as having an age-inverse dominance hierarchy. To elucidate this, an 11-month study was carried out on 2 multimale groups in 2010 (1792 H focal observations). Both groups inhabited upland habitat, and were similar in size and adult sex ratio. Group 2 (G2) has been documented as relatively stable over time, while capture records since 2000 indicate that membership in group 12 (G12) has been quite fluid. During this study, G2 had 4 males and no animals immigrated/emigrated, while G12 had 5 males, but 2 males and 2 females emigrated. Dominance hierarchies were determined from dyadic agonistic interactions. Male hierarchies were strongly linear ($h^i=1.0$) with similar steepness scores (G2: $Dij=0.690$; G12: $Dij=0.674$). Close rank distance between the two highest ranking males in G12 suggested similar status. There was no relationship between age and rank in either group (G2: $R^2=0.226$, $p=0.525$; G12: $R^2=0.407$, $p=0.247$). While lacking specific historical observations, the 3 remaining males in G12 are close in age and currently appear cohesive. In G2, there is a documented secondary transfer who joined the group in 2004 at age 13, an older age than a “normal” primary transfer, and he soon attained alpha rank. If dates of achieving alpha rank in G2 are used instead of chronological age, there is a perfect reverse hierarchy based on date of “dominant achievement”, not age. In the absence of secondary transfers, dates of becoming dominant would correspond to age, and both would reflect an inverse hierarchy.

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Biomechanical implications on the onset of walking.

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In 2003, Ruff detected a developmental shift in the ratio of femoral to humeral strength in a longitudinal sample of children from the Denver Growth Study, which was associated with the adaptation of bipedal locomotion. However, it is unclear if this transition can be detected using archaeological, cross-sectional data, which is likely to contain additional error relative to longitudinal studies. This analysis is the first to explore whether the developmental onset of walking can be identified in the long bones of a large, temporally diverse sample of immature individuals.

Ratios of femoral, tibial, and humeral strength from seven samples of individuals under the age of eighteen (n=436) were explored using the cross-sectional polar second moment of area. The patterns detected in the analysis of recent modern humans were compared to a very small sample of Late Pleistocene Neandertals and modern humans. Despite great variation, clear changes in these ratios were identified around the age of the onset of walking. In addition, these ratios differ by sample, although the differences detected appear to be closely related to differences in crural index among samples. In

addition, Neandertals displayed significant differences in their long bone ratios around the onset of walking. However, the extremely small fossil sample available in the relevant age group makes these differences difficult to interpret. Further research in this area may provide additional information about the onset of walking in the past and in additional fossil groups.

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Mitochondrial DNA analysis of human remains recovered from the Fontabelle section of Bridgetown, Barbados.

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In the year 2000 an emergency excavation was conducted to recover skeletal material from an unmarked graveyard in the Fontabelle section of Bridgetown, Barbados. Though poorly preserved, the osteological analyses supported the archaeological and socio-contextual evidence that these individuals were most likely members of the city's enslaved and freedmen populations from the mid-17th and 18th centuries.

While definitive, one further question remained. What was the macro-ethnic affiliation of these individuals, and would the results support these assessments? To help answer this question, a pilot study was performed that involved the extraction of mtDNA from several fragmented elements, including one cranial fragment, three femora, and two teeth. PCR amplification of hypervariable regions I and II of the mtDNA was successful from one femur and one tooth. Initial analysis of the mutations present in the amplified mtDNA indicates that both samples belonged to individual(s) from haplogroup L, thus suggesting an African origin of the human remains.

A macroscopic analysis of infantile scurvy from Zape, Mexico (AD 600-1430).

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The examination of scurvy by paleopathologists has provided increasingly innovative diagnostic methods for identifying and assessing the impact of this metabolic disorder in past populations (e.g., Schultz 2001; Brickley and Ives 2008). Recent work on the macroscopic analysis of scurvy in non-adult skeletal remains suggests that diagnostic criteria for identifying scurvy in immature individuals may be different from those applied to adult remains (Brown and Ortner 2011). Additionally,

this same study argued that lesions on the pelvis suggest severe manifestations of the disease.

Data are reported for the mummified and/or skeletonized remains of 11 infants from Zape, Mexico. Given the unique context of these interments (burial complete with shrouds, pillows, grave goods and clay architecture), it is likely that these infants were buried in a ritual manner and therefore the sample of infants may not reflect typical patterns of infant health. Although the sample size is small, 5 (45%) of the infants show lesions suggestive of scurvy. The patterning of periosteal lesions is described in detail, with an emphasis on examples from two of the infants who exhibit widespread lesions, both consistent with severe manifestations of the condition. Comparisons to clinical data demonstrate that lesions present on the mandibles, crania, scapulae and pelvic bones of these two individuals are consistent with micro-hemorrhaging near muscle attachment sites (e.g., Larralde et al. 2007). Overall, these data support an emerging interpretation of lesion patterns indicative of infantile scurvy and suggest that disease severity may in fact be reflected in lesion distribution and intensity.

Estimation of cranial capacity from linear measurements in juvenile orangutans.

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Previous studies have described methods for cranial capacity estimations in humans and chimpanzees from linear measurements. In the present study, cranial capacity of individual dry juvenile orangutan crania were measured using the conventional filling method and additional linear measurements of length, breadth and height were also taken. The linear measurements were then used to generate a linear regression function that allows for predictions of cranial capacity. The linear measurements were then cross-checked with the volumetric data to reveal a possible method for estimation of cranial capacity in juvenile orangutans. The applications of the method outlined in this study are comparable to similar methods used for humans and chimpanzees. No previous work on orangutan cranial estimation has been published, so this report establishes a basis for future work on juvenile orangutan crania.

The thumb of *Homo floresiensis*: first comparative analyses of the proximal and distal pollical phalanges from Liang Bua.

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Only one thumb bone, a distal pollical phalanx (LB1-55), has thus far been described for *Homo floresiensis*. Although LB10 was initially identified as a hallucal proximal phalanx in part because of its thick ovoid diaphysis, newly identified hallucal proximal phalanges of *Homo floresiensis* indicate that LB10 is a pollical proximal phalanx. Here we compare the thumb phalangeal morphology of *Homo floresiensis* with that of a large sample of living apes and extant and fossil hominins. Our univariate and multivariate results show that both *Homo floresiensis* pollical phalanges are characterized by proportionally thicker midshafts and smaller articular surfaces than in the modern human sample. LB10 also exhibits significantly greater proximal height compared with modern humans and in this respect is more similar to the relatively robust proximal phalanges of gorillas. Overall, the morphology of LB10 is more human-like than is the proximal pollical phalanx of *Australopithecus afarensis* (A.L. 333-69). LB1-55 is characterized by a well-marked insertion of the *flexor pollicis longus* and a modern human-like apical tuft shape, and differs from the modern human sample mostly in size. Using size-adjusted variables, LB1-55 falls within the observed modern human variation, being characterized by a small proximal articular surface and a thick midshaft. In these respects, LB1-55 differs considerably from living apes and other fossil hominins. The combination of characteristics seen in the *Homo floresiensis* thumb phalanges raises important questions about the biomechanical implications of small articular surfaces associated with a strongly reinforced midshaft, and about the evolution of thumb morphology in hominins.

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Secular change in the femoral head in modern Americans.

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The recognition of secular changes in various aspects of the skeleton has been an area of continuing investigation for anthropologists as the presence of secular change can provide indications of populational response to ongoing environmental transitions. Trend comparison among cohorts reveals degrees of change experienced among groups within a single population or between groups. Studies typically employ linear regression to identify morphological changes over time; however trends are not necessarily linear in nature. In this study, secular changes in the femoral maximum vertical head diameter (MVHD) of American males and females were evaluated through the application of advanced statistical methods appropriate for time-series data and the identification of trends

Femoral head diameters of 19th Century and modern Americans (n=1,217) were analyzed from the Robert J. Terry Anatomical Collection, the M. F. Erickson Collection, and the University of Tennessee Forensic Data Bank. Two cohorts categorized by sex were evaluated for autocorrelation before performing additional

statistical analyses. Statistical evaluation for the male sample was executed via an Autoregressive Integrated Moving Average (ARIMA) model of the average MVHD variable on the year-of-birth variable, and a subsequent regression analysis of lag first-differences on a five year year-of-birth variable. ARIMA results indicate the male average head diameter appears to fluctuate in size over time. Piecewise regression analysis, employed to identify the trend in the females, indicate an increase in size until the early 1900s and rapid decrease thereafter. Results suggest differential environmental pressures acting on this particular aspect of the skeleton among males and females.

The stability of “Maximum Ingested Bite Size” over time.

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In summer 2006, we examined Maximum Ingested Bite Size (Vb), i.e., the largest piece of food that an animal will ingest whole without biting first, for three foods (carrot, melon and sweet potato) and seventeen species of strepsirrhines at the Duke Lemur Center. We found that frugivores consistently eat larger pieces of food than do folivores. This signal correlates with that seen in masticatory fiber architecture. Thus Vb appears to be an important link between behavior and anatomy – assuming that it remains consistent over time. To confirm the temporal stability of Vb, we repeated our experiments on a subset of the original individuals in summer 2011. Due to deaths and transfers, our repeated sample is small (six individuals, four species), but across all foods and animals, the average absolute difference is 10.16%. Given that the Vb values in this sample average <15mm on a side, this average percent difference is only slightly more than the precision of our cutting tools. The repeated samples are statistically indistinguishable (using a Related Samples Wilcoxon Sign Rank Test) for both carrot and sweet potato. However, the animals consumed slightly (though significantly) smaller pieces of melon in 2011. It is possible that the fruit used in 2011 were less ripe (more obdurate) than those of 2005, resulting in smaller bites. Thus we believe it is important to express Vb in terms of food mechanical properties measured during the study – a hypothesis tested in one of our other abstracts in this volume.

Cold, wet and hungry? Fluctuations in frugivore populations in response to extreme climatic events.

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Food availability, predators and disease are hypothesized to be three major forces shaping the size and demographic structure of primate populations. Extreme climatic events can also have dramatic, long-term impacts, but the contribution of such events to the observed structure of primate populations can be difficult to ascertain. Here, we report a population decline of as much as 70% in the white-faced capuchin (*Cebus capucinus*) population living on Barro Colorado Island (BCI), Panama that occurred in conjunction with a wet season characterized by unusually high rainfall, unusually low temperatures, and the failure of a keystone fruit species, *Dipteryx oleifera*. We use time series analyses to investigate how habitat-wide fruit production, climatic variables including rainfall and temperature, and predator density shape fluctuations in frugivore abundance on BCI over a 30 year period. Our results show a complex relationship between environmental variables and frugivore populations, and indicate that the factors that drive population fluctuations in response to extreme climatic event do not necessarily explain year to year variation in population sizes.

A reanalysis of thermoregulation in *Homo erectus* and Neanderthals.

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Thermoregulation is widely thought to have influenced the size and shape of the bodies of the two best-known fossil members of the genus *Homo*, *Homo erectus* and *Homo neanderthalensis*. The narrow-bodied, long-limbed *H. erectus* KNM-WT 15000 has been interpreted as tropically adapted, while the stocky, short-limbed Neanderthals have been interpreted as polar adapted. However, there is reason to think that current methods of estimating thermoregulation are problematic. Most significantly, they are incapable of taking into account body segment differences in surface areas, skin temperature, and kinematics.

With the foregoing in mind, we carried out a study to determine whether the current consensus regarding thermoregulation in *H. erectus* and *H. neanderthalensis* is supported when segment-specific variables are used. The ratio of heat production to heat loss was estimated for two *H. erectus*, three Neanderthals, and eleven modern human skeletal samples. Individuals were modeled as walking, unclothed, in four ambient temperatures.

Our results generally support the current consensus regarding the thermoregulatory adaptations of *H. erectus* and *H. neanderthalensis*, but there were some unexpected findings. The whole-body heat production to heat loss ratios were consistent with the tropical and polar adaptation hypotheses for *H. erectus* and Neanderthals, respectively. However, the segment-specific ratios of heat production to heat loss were inconsistent with the idea that lower limb segments are more evolutionarily labile in response to thermal stress than upper limb segments.

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Quantifying edge effects using stable isotopes.

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Forest fragmentation creates abrupt boundaries between intact forests and matrix habitats. Edge effects occur when abiotic and biotic conditions from the matrix penetrate into the forest interior. Such effects are relevant to the lemurs of Madagascar, which are severely threatened by forest loss and fragmentation. Traditionally, abiotic and biotic variables are measured separately. However, these factors are intrinsically linked. Stable isotope values in leaves provide an integrated measure of both abiotic and biotic edge effects. We surveyed and quantified carbon and nitrogen isotope values in tree leaves eaten by resident lemurs that were growing along a savannah-dry forest edge at Ankarafantsika National Park, northwest Madagascar.

We predicted that both carbon and nitrogen isotope values would be highest close to the savannah border, where trees are exposed to more sun, drier air and higher temperatures, and that they would decrease with increasing distance from the savannah border. Instead, we found (i) a negligible relationship between carbon isotope values and distance from the edge, and (ii) a strong positive relationship between nitrogen isotope values and distance from the edge. We attribute these patterns to a gradient in soil chemistry between the savannah and the forest interior. Whereas forest soils are nutrient-depleted sands, savannah soils may have a higher nutrient and moisture content. These patterns will be useful for tracking consumption or avoidance of edge resources by resident lemurs.

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Female dominance and feeding behavior in Verreaux's sifaka in the Kirindy Mitea National Park.

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Female dominance is generally associated with female feeding priority. Thus female dominant species are expected to feed more on preferred food resources and for longer durations. Verreaux's sifaka (*Propithecus verreauxi*) is an arboreal, folivorous lemur that lives in social groups of two to thirteen individuals and exhibits female dominance. We tested the hypothesis that female dominance causes sex differences in food intake. We examined the feeding behavior of four social groups of Verreaux's sifaka in the Kirindy Mitea National Park. Focal animal sampling was used to collect data on fifteen individuals (eight females, seven males) from January to December

2008. We examined the proportion of time spent feeding on the top fifteen preferred food species. Even though Verreaux's sifaka are female dominant, we found that males and females generally did not significantly differ in the proportion of time they spent feeding on the preferred food species. We found that females did spend a significantly greater proportion of their feeding time on *Givotia madagascariensis* and a trend for females to feed more on *Bauhinia porosa* than males. Interestingly, we found no sex differences in feeding behaviors for species known to be high in tannins, such as *Albizia perrieri*, even though female sifaka have been suggested to seek out tannin-rich foods. While we did not examine food quality, food intake rates, or feeding order, our results suggest that female dominance does not generally lead to females spending a greater proportion of their time feeding on preferred food species than males.

Physiological stress in a multi-ethnic cemetery population from colonial Campeche, Mexico.

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The cemetery associated to the early colonial church in Campeche (México) harbored the skeletal remains of a heterogeneous community formed by natives, mestizos, Europeans and Africans, some being locals, others foreign-born. This early colonial multi-ethnic society survived the harshness of famine and epidemics that made living conditions precarious. The present work infers impact of stress on health and living conditions within this multi-ethnic society. Updated macroscopic and chemical analyses of stress and pathological markers in the 150 individuals from the graveyard indicates differential exposure to developmental stress between locals and foreigners, with foreign Africans showing significantly less linear enamel hypoplasia than locally-born Africans, natives or mestizos. Conversely, periostitis and osteomyelitis provide a different scenario, with all foreign Africans showing bony reactions, in comparison with 75% of the locally-born Africans and 45% to 50% in natives and mestizos. However, the reduced number of Africans suitable for skeletal analyses implies caution. The Africans were probably employed in the Spaniards' households, while natives and mestizos were from a more heterogeneous social background. Nevertheless, with the exception of linear enamel hypoplasia, the skeletal and chemical information does not discriminate between Africans and the indigenous population. The different amount of LEH in foreign-born Africans is likely the result of the forced selection that took place in their own native lands before being carried to the Americas. For the rest, once the individuals had eventually settled down in Campeche, they were exposed to similar external pressure and faced similarly difficult living conditions despite their social role.

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Ancient DNA analysis suggests temporal stability in mitochondrial genomes of the Northwest Coast.

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After European contact Native American populations collapsed due to the introduction of infectious disease and warfare. This drastic population bottleneck was hypothesized to result in large differences in allele frequencies in the same population pre- and post-European contact due to genetic drift.

In order to test the hypothesis of temporal stability of mitochondrial genomes on the Northwest Coast, DNA were extracted from human teeth recovered from ancient sites located on British Columbia's Central Coast and radiocarbon-dated to 1,000-5,000 calibrated years before present. These extracts were prepared for both conventional polymerase chain reaction (PCR)/Sanger DNA sequencing and next generation DNA sequencing technologies (Illumina Genome Analyzer). All ancient mitochondrial genome sequences of ancient individuals were compared to mitochondrial genome sequences of contemporary Native American population on the Northwest Coast.

Our results suggest a pattern of temporal stability over 5,000 years of mitochondrial genomes in populations on the Northwest Coast. Our results are in agreement with previous studies that showed patterns of temporal stability in mitochondrial haplogroup frequencies in populations residing in other regions of North America. Collectively, these results suggest that mitochondrial genome variation experienced little disruption during the population collapse following European contact.

Twa (pygmies) and the comparative energetics of gathering and farming: the energetic significance of the transition to agriculture.

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One of the most enduring concepts in anthropology is the perception that farming incurs greater energetic costs than hunting and gathering. Much of this concept stems from the seminal work of Lee and the subjective impressions of Dobe-area !Kung living in the 1960s. Although the !Kung had little direct experience with farming, there have been few quantitative attempts to verify their views. As a

result, the comparative energetics of human subsistence activities are virtually unknown. Here we report on a population, the Twa of southwestern Uganda, that was forced to shift from hunting and gathering to subsistence farming in 1991. We measured the energetics of women resting, standing, foraging (on- and off-trail), and digging for wild yams (*Dioscorea* spp.) in Bwindi Impenetrable National Park. Repeated measures were also performed for a laborious agricultural task – hoeing – that was also associated with underground tubers. We found that the cost of hoeing, measured by VO₂ kg⁻¹ min⁻¹, was significantly higher than all aspects of foraging in the forest, including digging.

A contributing factor to this result might be the short stature (pygmy phenotype) of the Twa. A relatively lower surface area to volume ratio is expected to constrain the benefits of evaporative cooling under warmer temperatures. Thus the high energetic costs of farming – both real and perceived – might be due in large part to the small stature of human hunter-gatherers. We suggest that a size-related ability to mitigate thermal and energetic costs might have been a key factor in the origins of farming.

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Variation in rates of tooth wear in a single primate population: effects of sex and microhabitat.

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Tooth wear rates are assumed to be consistent across individuals in single primate populations, with wear stages frequently used as a proxy for estimating ages of unknown individuals, including fossils. We present tooth wear rates in a single ring-tailed lemur population from the Beza Mahafaly reserve, southwestern Madagascar. Individuals ($n = 32$) are first captured at two years old, are recaptured annually and are of known age. Wear rates were calculated based on yearly ordinal wear scores across three field seasons, and were compared by sex and across and within two microhabitats. Females living in the non-river margin microhabitat show significantly lower rates of molar wear ($p = 0.0069$) than females in the river margin area of the reserve. Females in the non-river margin microhabitat have lower molar wear rate ($p = 0.0008$) than males in the same microhabitat, but no sex differences occurred within the river margin microhabitat. Male rates did not differ between the two microhabitats. Higher male wear rate in the non-river margin microhabitat likely reflects their more frequent use of mechanically challenging tamarind fruit. Higher rate of wear among river margin females probably results from using physically challenging foods, especially introduced plants not used by lemurs living away from the river margin. Our data illustrate that within species, individual tooth wear rates can vary substantially both between and within groups. This lack of a species-specific wear rate suggests that use of

this attribute as a proxy for age of fossil primates should be approached with caution.

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Human ribs six through nine: sexual dimorphism and seriation using geometric morphometrics.

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Though human ribs present a challenging case in terms of identifying sex and position in the ribcage, both are essential for thorough forensic investigations. The latter aspect is especially important for determining if trauma occurred to the chest and the sequence in which it occurred. In order to accurately do so, it is imperative to be able to seriate the ribs. This study presents an investigation of ribs six through nine, which are notoriously difficult to differentiate.

Semilandmarks were collected across the superior border of each rib ($n = 42$) with a Microscribe, producing a three-dimensional curve. Each curve was resampled in Rhinoceros to have the same number of semilandmarks, which were then submitted to generalized Procrustes analysis. In order to reduce the number of variables prior to canonical variates analysis (CVA), a principal components analysis was conducted and a reduced number of variables (principal components) were submitted to CVA. Cross-validation results for sex returned an accuracy of 82% correct reclassification, while for rib position results of 75% correct reclassification were returned.

Thus, a new method is available to not only sex human remains using ribs, but also a way in which to seriate ribs six through nine, which will allow for more accurate reconstructions of trauma and improve estimation of age based on ribs.

The transition between quadrupedal and bipedal gait in hominoid and cercopithecoid models.

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Our insight into the mechanics of primate locomotion in general, and human bipedalism in particular, has greatly benefited from experimental data on living primates and biomechanical modeling. Different gaits (quadrupedal/bipedal, terrestrial/arboreal etc.) have been addressed, but it remains largely unknown how exactly transitions between gaits are performed. Tackling this issue can help understand the mechanics and cost of this frequently used behavior in primates, but also inspire the design of more flexible (in terms of gait selection) robots.

Here we study terrestrial quadrupedal-to-bipedal transitions in two morphologically distinct species, focusing primarily on joint kinematics and center of mass (CoM) dynamics. The arboreal bonobo (*Pan paniscus*) has a CoM position shifted backwards, considered typical of primates. The terrestrial Olive baboon (*Papio anubis*) has a CoM position about equally distributed between the fore- and hind limbs. Data were collected using lateral-view high-speed videography.

Despite differences in mass distribution, both model species achieve upright locomotion in a similar fashion, which involves moving and loading the leading hind limb in front of the center of pressure during the transition step, generating rotational momentum around the center of mass. This results in more orthograde trunk position and bipedal gait. When compared to humans, the mechanism observed in both non-human species involves far smaller vertical CoM displacements, and therefore quadrupedal-to-bipedal transitions might be relatively cheap.

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Oral health and implications for diet in the Early Holocene Paleoindians of Lagoa Santa, Brazil.

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The Lagoa Santa region in central Brazil has produced dozens of human skeletons dated to the early Holocene (ca. 10,000-7,000 yBP). This series provides the opportunity to investigate oral health and to draw inferences about diet and nutrition of early Holocene South Americans. Paleoindian diet has been the focus of current debate regarding the classic model of big-game hunters versus a generalized subsistence strategy. We test the hypothesis that Paleoindians of Lagoa Santa show oral health similar to foraging populations. For comparison, we use a large database of archaeological populations from the History of Health in the Western Hemisphere Project ($n=6,566$). Prevalence of caries in Lagoa Santa is 7.9% of teeth ($n=917$) and 63.0% of individuals affected ($n=27$). These prevalences depart significantly (chi-square; $p<0.05$) from the forager populations in the Western Hemisphere database (3.6%, teeth; 31.6%, individuals). The analysis shows significantly higher prevalence of carious lesions in Lagoa Santa females (21.6%, $n=111$) than in Lagoa Santa males (5.2%, $n=287$). In addition, males have significantly higher tooth wear (4.26 vs. 3.96), whereas females have higher antemortem tooth loss (9.4% vs. 3.5%). These results suggest the consumption of a relatively high carbohydrate diet in Lagoa Santa Paleoindians, supporting the hypothesis of a diverse diet, including significant plant consumption. Furthermore, we detected significant sex differences in diet, with a more cariogenic diet for females. Our findings suggest consumption of tubers, fruits, and other potentially cariogenic plants present in the Brazilian savannah biome today.

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Subadult age estimation at Tell-el Amarna: a systematic, site-specific approach.

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When dental hard tissues are incomplete or absent, estimation of subadult age generally relies on long bone lengths and the degree of epiphyseal fusion. Unfortunately, both long bone growth and epiphyseal fusion are commonly affected by health and nutritional status, complicating the process of age estimation when dental tissues are lacking. Beginning at approximately 7.5 months, significant growth delay in the subadult sample ($n=94$) at Tell el-Amarna, Egypt (1352-1336 BCE) presents dichotomous age estimates for individuals possessing both dental tissues and complete long bones for age estimation. The dental age estimates average 20 months in advance of the long bone age estimates based on the Maresch standards. Clearly, age estimates based on long bone length using modern standards would be far too young, skewing the demographic profile and adversely affecting analyses based on that profile. This study reports on a systematic method for standardizing long bone lengths to dental development at a specific archaeological site, and produces metrics for age estimation using long bone lengths applicable to this, and potentially other, New Kingdom Amarna Period Egyptian sites. The method described can be applied to any archaeological site with large subadult samples to first test for the presence of significant biological insult, and second to ensure the demographic profile built from the skeletal remains is representative of the actual population.

Osteonal bone density in the mandibles of West African colobines.

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The sympatric West African red colobus (*Procolobus badius*) and king colobus (*Colobus polykomos*) are distinguishable by aspects of both skeletal morphology and diet. At Tai Forest, king colobus consume greater amounts of mature leaves than do red colobus, while also heavily exploiting the ligneous seeds pods of *Pentaclethra macrophylla*. These observations suggest that the *Colobus polykomos* diet is significantly tougher than that of *P. badius*, perhaps resulting in greater daily masticatory and ingestive activity in the former. Under the hypothesis that greater load frequency predisposes mandibular bone to fatigue failure, we expect remodeling activity to be greater in primates processing tougher diets.

We prepared thin sections from the postcanine mandibular corpus in four adult

specimens each of red and king colobus for examination of secondary osteonal density and area. We employed analysis of variance to examine osteonal bone variation associated with species, sex, cortical plates (buccal vs. lingual) and region (alveolar process vs. basal corpus). Variation is primarily idiosyncratic; that is, we observed no regional, sex or species effects. There is significant variation between cortical plates, which reflects higher osteon density in the buccal cortex, particularly in *P. badius*.

Thin sections of mandibular bone in the hard-object specialist *Cercocebus atys* yield values for osteon density below those observed for these colobines. In this particular case, the high-load environment inferred for durophagy is not associated with elevated remodeling activity. These data underscore the uncertain relationship between food material properties and metabolic activity in mandibular bone.

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Weaning, age identities and embodiment in the South Central Andes: a preliminary paleodietary investigation using carbon and oxygen stable isotope analysis.

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Andean ethnographic and ethnohistoric documents demonstrate that the weaning process played a significant role in the embodiment of social connections and transitions across the life course. Current knowledge of infant feeding practices in the prehistoric Andes consists of a small body of bioarchaeological research. Using light stable isotope data from thirteen individuals from the Middle Horizon (500-1000AD) Tiwanaku-affiliated Bolivian sites of Kirawi, Lukurmata and Tiwanaku, we investigate whether weaning was rigidly structured within these communities, or a process with pan-Andean chronological, biological or social cues.

We use the stable carbon and oxygen isotope signals of enamel to monitor the processes of dietary supplementation ($\delta^{13}\text{C}$) and changing water sources ($\delta^{18}\text{O}$) associated with weaning. Carbon and oxygen stable isotope results demonstrate inconsistency in weaning times within sites. Across sites, the highest $\delta^{18}\text{O}$ values are associated with first molars ($\bar{x}_{\text{apatite}}^{18}\text{O} = -8.2\% \pm 1.9$, 1σ , $n=9$) with a decrease in later forming teeth (P3, M2, M3: $\bar{x}_{\text{apatite}}^{18}\text{O} = -11.2\% \pm 1.2$, 1σ , $n=6$), indicating juveniles were commonly weaned within three years of birth. Stable carbon isotope values are elevated in first molars and incisors on average $0.9\% \pm 0.3$ (1σ , $n=40$) over later forming dentition, suggesting the introduction of C_4 foods between three months and seven years of age.

Results indicate that weaning may have been more closely tied to large-scale Andean social conceptions of aging than community-specific chronological markers. Sex-based distinctions in weaning times and supplemental foods employed during this process indicate gender may have impacted weaning behavior, presenting prolific ground for future research.

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Body mass prediction: the accuracy of estimating overweight individuals.

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Body mass estimation is a vital part of many investigations within biological anthropology. Methods to estimate body mass are based on individuals that fall within a normal range of weight (BMI=18-24.9). Predictive equations are then utilized on all individuals, regardless of BMI range, in order to estimate body mass. This study seeks to ascertain how accurate four current methods of estimating body mass are for a sample of documented overweight individuals. For this research, 18 measurements were recorded on 174 skeletons ($n=128$ males and 46 females) from four documented collections (Hamann-Todd, Robert Terry, William Bass, and Maxwell Museum).

The predictive methods evaluated for this study are bi-iliac breadth and height (Ruff), subtrochanteric area (McHenry), femoral head dimension (Grine and colleagues), and the multiple element model (Daneshvari). A paired t-test was performed to evaluate the accuracy of estimating body mass on overweight individuals (BMI ranging 25-29.9), by sex. All predictive estimates are significantly different from the recorded weight (p -values <0.0001). All masses were underestimated and males had a greater difference between estimated and actual body mass than females. For estimating male body mass the method by Grine and colleagues produced the least average error (8.7 kg), while for females it was as two methods, that by Daneshvari (10.18 kg) and Grine and colleagues (11.24 kg). Additionally, after a mass of 70 kg is attained, all methods cannot detect additional mass from skeletal measures suggesting that at a certain point the skeleton stops responding to the stressors from weight.

“Following,” an alternative mating strategy used by male olive baboon (*Papio hamadryas anubis*): description and outcomes.

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Recent studies indicate the potential evolutionary significance of alternative strategies across many taxa, including humans (Gangestad and Simpson 2000). Although sexual behavior is well studied in primates, the use and function of alternative mating strategies has received less attention in primates than in other taxa. In baboons, solo competition for consortships has been emphasized as the primary male mating strategy. Our study examined whether a conspicuous, but little-studied male behavior—persistent “following” (of consortships)—is an alternative mating strategy. Two habituated groups of olive baboons were studied from

September 2009 to July 2010 in Kenya. We describe the behaviors surrounding 100 observed consort “takeovers” involving 24 adult males. Approximately 71% of such takeovers were executed by males who were followers of the targeted consortships. Moreover, the percentage of consort takeovers by followers increased (up to 92%) during the periods of likely ovulation. Although solo challenge accounted for 19% of takeovers, three other tactics were used by males: coalitionary challenge with another male (10%), and exploitation of both an abandoned consort female (34%) and another male’s challenge (37%). While both followers and nonfollowers used all four tactics, 89% of coalitionary challenge and solo takeovers were carried out by followers. The high percentage of takeovers by followers and the fact that both coalitionary and solo takeovers were primarily carried out by followers suggests that following is a critical part of the overall system of competition and challenge. These findings broaden our understanding of the nature of mate competition in male olive baboons.

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Measuring up: the analysis of postcranial traits for the assessment of biological distance among temporally distinct New World populations of African descent.

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Biological distance studies measure the degree of relatedness or divergence between populations or subgroups within populations based upon polygenic skeletal and dental traits, and have proven useful in evaluating the effects of genetic and environmental factors on human diversity.

This study examines how postcranial genetic osteometric markers changed over time in four temporally distinct New World populations of African ancestry. Individuals from the 17th century Newton (Barbados) Plantation series, late 19th and early 20th century individuals from the Hamann-Todd collection, and mid-20th century individuals from the Bass/Forensic Database collection were utilized for this study, providing a sample of over 250 individuals. A total of 26 measurements that had been previously suggested as demonstrating differences by ancestry were taken on the os coxae, femur, tibia, and sacrum, as outlined in Buikstra and Ubelaker (1995). Data were analyzed using descriptive statistics as well as the C.A.B. Smith Mean Measure of Divergence and Mahalanobis D Squared testing.

Preliminary results correlate with expected changes. Males and females from Newton were more robust than individuals from the more contemporary populations. Interestingly, the greatest differences occur among the females of each collection, with leg measurements showing more change than those of the sacrum or pelvis. Crural index length also supports a dynamic change between the female groups, with values over time resembling those more generally seen in Europeans. These differences in skeletal dimensions are likely the

product of increasing genetic admixture as well as differences in habitual workload.

Human ecology of Lyme disease: establishing variability in exposure potential to tick populations.

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Lyme disease is the most prevalent vector-borne disease in temperate North America and is emergent across much of temperate Eurasia. Disease occurs when humans get caught in the ecological chain that sustains transmission and reproduction of the spirochete bacteria, *Borrelia burgdorferi* *sl.* Transmission to human beings occurs through an arthropod vector, the Ixodes (hard bodied) group of ticks. Infection of humans takes place after an infected tick has attached to a human host for a sustained blood meal of 24-48 hours. This is the only known route of infection to humans. Since diagnosis of Lyme disease remains elusive in many clinical settings, development of a reliable prediction algorithm for Lyme disease risk will be useful in designing public health strategies and clinical medicine. One such impediment to a reliable risk model is estimating human exposure to these arthropods. In the past for modeling purposes, tick densities have been uniformly assumed according to environmental conditions. We used an accepted tick dragging method to survey a wooded nature preserve used for recreation in southeastern Pennsylvania. Our findings indicate that tick densities are largely variable within a very small range over a three year period. This suggests that human exposure potential to infected tick populations in the same location changes over time. This variation is of particular importance for building reliable models, creating public health strategies and assessing disease risk.

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A new method for the study of the biomechanical properties of human long bones and its application to ecogeographic and behavioral variation.

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This paper introduces a new method for the calculation of biomechanical properties from 3D laser scans. This method holds advantages over traditional periosteal moulding approaches, including: complete automation, virtual sectioning at multiple locations, and greater control over section orientation.

A sample of 295 humeri and femora were scanned using a NextEngine 3D laser scanner. Biomechanical properties were calculated from external contours using custom-built software. Comparison of the results with periosteal mould and radiographic based methods was used to test the method at mid-diaphyseal locations.

Regressions between methods show r^2 values in excess of 0.99 and %SEE for total area of 1.6% and second moments of area between 3.3% and 10.1%. Despite strong correlations, the laser scanned sections tend to produce areas and second moments of area slightly lower than periosteal moulding, and higher than techniques including the endosteal boundary as would be predicted. The shape index I_x/I_y shows lower replicability confirming orientation issues in moulding techniques. The comparisons also highlight the importance of the periosteal contour in determining biomechanical properties.

Application of the method to variation across whole bones at 1% intervals (n=756) emphasizes varying roles for body shape variation and influences of activity in bone rigidity profiles. Proximal femoral shaft strengthening in wide-bodied hunter-gatherers and variable unilateral strengthening of the upper limb in certain groups is observed.

This study provides a new method for the calculation of biomechanical properties that allows investigation of whole bone variation in geometry and location-specific influences of activity across the skeleton.

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Let's get real about MSMs: reliability in scoring techniques.

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Studies of musculoskeletal stress markers (MSM) generally note relatively low rates of interobserver error. However, levels of error could vary depending upon the selection of attachment site and/or experience of observers. All could potentially affect the quality of MSM data and have notably negative effects on interpretation of activity patterns, especially given the small size of many taphonomically compromised bioarchaeological samples. This study assesses both intra and interobserver reliability in MSM scoring using 58 individuals from two Late Woodland/Mississippian skeletal series from west central Alabama. Using two primary scoring methods [(Hawkey and Merbs (1995) and Villotte et al. (2010)], seven evaluators representing a range of experience levels (undergraduate to PhD) recorded MSM expression at 17 muscle attachment sites on the long bones. Results strongly suggest that variability in scoring patterns were specific to MSM sites using both methods. Attachment

points such as supinator and popliteus that generally exhibited little morphological remodeling had overall high agreement among all scorers. Other sites, such as deltoideus and quadriceps femoris, that displayed greater morphological development showed a broad range of scores, with up to 20% of sites having scores assigned to non-adjacent categories on Hawkey-Merbs' three-point scale. No pattern by level of experience was evident. In contrast to interobserver results, intraobserver error levels were generally low. These findings suggest that MSM data must be carefully interpreted, especially concerning site selection, and data comparison across researchers, since this could adversely affect interpretation of specific activity patterns.

Scenarios for the early settlement of the Americas and the importance of recurrent gene flow with Asia.

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Different scenarios attempting to describe the initial phases of the human dispersal from Asia into the New World have been proposed during the last three decades. However, some aspects concerning the population affinities among early and modern Asians and Native Americans remain controversial. Specifically, contradictory views based mainly on partial evidence such as skull morphology or molecular genetics have led to hypotheses such as the 'Two Waves/Components' and 'Single Wave' or 'Out of Beringia' model, respectively. Alternatively, an integrative scenario considering both morphological and molecular variation has been proposed and named as the 'Recurrent Gene-Flow' hypothesis. This scenario considers a single origin for all the Native Americans, and local, within-continent evolution plus the persistence of contact among circum-Arctic groups. Here we analyze 2D geometric morphometric data to evaluate the associations between observed craniometric distance matrix and different geographic design matrices reflecting distinct scenarios for the peopling of the New World using basic and partial Mantel tests. Additionally, we calculated the rate of morphological differentiation between Early and Late American samples under the different settlement scenarios and compared our findings to the predicted morphological differentiation under neutral conditions. Also, we incorporated in our analyses some variants of the classical Single-Wave and Two-Waves models as well as the Recurrent Gene-Flow model. Our results suggest a better explanatory performance of the 'Recurrent Gene Flow' model, and provide additional insights concerning affinities among Asian and Native American circum-Arctic groups.

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Human bacterial DNA from dental calculus: a new source of genetic material.

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The diversity and evolution of human populations have been systematically analyzed through polymorphisms in the human and microbiome genomes. In fact, several microorganisms have been used to infer microevolutionary events of their human hosts.

The aim of this investigation is contribute to the study of human bacterial flora as an indirect genetics marker of human populations from a new source of genetic material: dental calculus. This material can be analyzed in current and ancient samples, and it has not been genetically analyzed before.

Recent and archaeological DNA samples, as old as 4,000 YBP, were successfully extracted and amplified following all the required controls for ancient DNA. Species-specific PCR primers were designed in order to identify five species (*Actinomyces naeslundii*, *Fusobacterium nucleatum*, *Streptococcus gordonii*, *Streptococcus mutans* and *Porphyromonas gingivalis*). Of these species, *F. nucleatum* was the most frequent, founded in all the recent samples and around 40% from ancient samples. Also, in this bacterium we observed the presence of two or more genetic variants from the same individual, which were detected through DNA cloning.

Genomic analysis of bacteria from dental calculus is a promising source of evidence for paleopathological and microevolutionary studies, focused either on microorganisms or their human hosts.

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Strontium isotope ratios of mammalian fossils from Malapa, South Africa.

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Strontium isotope (⁸⁷Sr/⁸⁶Sr) ratio data have recently been used to investigate ranging and residence patterns among early hominins in South Africa (Copeland et al. 2011, *Nature* 474: 76). The ⁸⁷Sr/⁸⁶Sr ratios recorded in mammalian teeth reflect the ⁸⁷Sr/⁸⁶Sr ratios of the geological

substrates on which individuals live, thus they are proxies for landscape usage patterns in hominins and other mammals. In the present study we provide ⁸⁷Sr/⁸⁶Sr ratio data for a sample of fossil rodents, lagomorphs, bovids, and a single adult female of *Australopithecus sediba* (MH2) from the site of Malapa, South Africa. The ⁸⁷Sr/⁸⁶Sr ratios of these teeth were measured using laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS), a minimally destructive sampling technique. The rodents and lagomorphs reveal ⁸⁷Sr/⁸⁶Sr ratios indistinguishable from the dolomites housing the fossiliferous caves, suggesting that they lived and died on the dolomites, which is consistent with the small home ranges of these micromammals. The larger bovids, on the other hand, appear to be non-local, thus they spent at least some portion of their lives on a substrate other than the dolomites where they died and were deposited. Sampling of a small chip of enamel from the M² of MH2 reveals a ⁸⁷Sr/⁸⁶Sr ratio just outside the maximum value recorded for the local dolomites. This suggests that this individual had either ranged beyond the dolomites during her juvenile years, or that she had dispersed from a remote geological substrate to the local dolomites where she was ultimately buried, possibly upon reaching reproductive maturity.

Can caudal vertebral body articular surface shape discriminate among prehensile and non-prehensile tailed anthropoids?

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The prehensile tail, capable of suspending the entire body weight of an animal, has evolved twice (in parallel) in New World monkeys (Platyrrhini): once in the monophyletic Atelinae (*Alouatta*, *Ateles*, *Brachyteles*, *Lagothrix*), and once in *Cebus*. Structurally, the prehensile tails of atelines and *Cebus* share morphological features that distinguish them from non-prehensile tails, including longer proximal tail regions, well-developed hemal processes, robust caudal vertebrae resistant to higher torsional and bending stresses, and caudal musculature capable of producing higher contractile forces. The functional significance of shape variation in the articular surfaces of caudal vertebral bodies, however, is relatively less well understood. Given that tail use differs considerably among prehensile and non-prehensile anthropoids, it is reasonable to predict that caudal vertebral body articular surface area and shape will respond to use-specific patterns of mechanical loading.

Here we examine the potential for 3D shape analysis to discriminate among a mixed sample (n=22) of wild-shot prehensile- and nonprehensile-tailed platyrrhines and nonprehensile-tailed cercopithecoids. Proximal and distal caudal vertebral body articular facets for the first caudal vertebra, transitional vertebra and longest vertebra were laser scanned and modeled as quadric functions. Results indicate that the distal articular surfaces of prehensile tail caudal vertebrae are more convex (i.e., have

more pronounced surface curvature) relative to nonprehensile tail vertebrae, and these differences are most pronounced in the longest vertebra. Pronounced articular surface curvature is potentially associated with enhanced lateral joint excursion, joint congruence or some combination of factors relating to postural stability of the tail during use.

Cortical bone density determined with microCT in the chimpanzee and gorilla facial skeletons.

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Moderately correlated with elastic moduli and yield strength, bone density is a partial determinant of bone quality and can be used in behavioral assessment as an indicator of bone remodeling, tissue age, and functional adaptation. It must be determined for estimates of 3D elastic properties for finite element modeling, a numerical technique for understanding the functional behavior of skeletal organs. The bone density measurement standard is through using Archimedes principle and densitometry apparatus based on accurate scale measurements. This requires preparation of small samples and does not allow continuous cortical sampling. MicroCT is a 3D radiographic technique which is used to examine hard tissue structure and with adequate calibration, might be used for determining continuous variations in bone density. This study compares density measured by these techniques. 40 cylindrical bone specimens from the gorilla and chimpanzee facial skeletons were used. Cortical specimens were scanned with a Scanco MicroCT 35 at a resolution of 3.5 microns. Apparent and material densities were estimated using Scanco's calibrations. Results showed variation in cortical density varying between 1400 and 2000 mg/ccm. MicroCT estimates of apparent density were lower ranging from 700 to 1000 mg/ccm yet were highly correlated with values measured by standard technique at R=0.95. Material density was correlated at a significant but lower level (R=0.75). These findings suggest that microCT can be used to assess continuous variations in apparent bone density and might be useful for gathering material property data for use in finite element studies of primate craniofacial skeletal function.

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Implications of functional single nucleotide polymorphisms in Manitoba First Nation health.

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In Canada, there exists a large disparity in health status indicators between First Nation and non-First Nation populations. While socio-economic factors influence health, increased susceptibility to infectious disease has been associated with functional single nucleotide polymorphisms (SNPs) in promoter regions of cytokines and chemokines. With the support of First Nations communities, this study investigated immunogenetic variability and explored how genetics and the unique histories of these groups may contribute to differential resistance and/or susceptibility to infectious diseases.

DNA samples were collected from Dene, Saulteaux, Cree and Caucasian cohorts within the province of Manitoba. SNPs in Interleukin-12 (IL-12p40) promoter and in genes encoding the Toll-like Receptors 2 (TLR-2Arg753Gln) and 4 (TLR-4Asp299Gly, Thr399Ile) were typed using PCR-RFLP analysis. The relationships between ethnicity and SNP frequency were statistically examined.

Compared with the Caucasian and Saulteaux populations, the Dene and Cree were found to have a significantly higher frequency of SNPs associated with the low expression of IL-12, while variation within TLRs was not statistically significant. The lower production of the IL-12p40 subunit has been previously associated with the down-regulation of a Th-1 immune response—a response that is essential for the containment of *Mycobacterium tuberculosis*.

These results have identified variations in key immunological pathways between First Nations and Caucasians as well as within First Nation cohorts. The First Nations groups have unique cultural, political and historic identities and the contemporary immunogenetic profiles are likely a reflection of these histories. This, combined with socio-economic conditions, may be contributing to differential disease susceptibility.

This study was funded through Canadian Institutes of Health Research, the National Sanatorium Association and internal funds from the University of Manitoba.

Lines of least evolutionary resistance and the evolution of the canine honing complex.

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Previous research has shown that the elements of the canine honing complex are strongly linked pleiotropically in both male and female anthropoids. Additionally, the elements of the complex are characterized by significant among species correlations, indicating that the complex has coevolved in both sexes. This study addresses the hypothesis that lines of least evolutionary resistance (i.e., the vector describing the maximum within-population variance) are shared among species. Additionally, as evolutionary changes between populations in directions not aligned with this vector are relatively constrained, then among-species differences should be strongly correlated

with this vector. These hypotheses were tested for seven dimensions of the canine honing complex (height, mesiodistal, and labiolingual dimension of each canine; the length of the premolar's honing surface) for 10 female samples (8 catarrhine; 2 platyrrhine) and 4 male samples (3 catarrhine; 1 platyrrhine). Every dimension was recorded for a minimum of 15 individuals for each sample. Using a randomization procedure, the null hypothesis that lines of least evolutionary resistance are shared was rejected in only 2 of 45 comparisons for the females and only 1 of 6 comparisons for the males. In contrast, the null hypothesis that among divergence accumulated along shared lines of least evolutionary resistance was rejected in 64 out of 90 comparisons for females and 8 out of 12 comparisons for males. Despite sharing similar patterns of covariation within species, the elements of the complex have changed in dimensions not aligned with the vector of maximum variance.

Anatomical and biological reconstruction of mortuary rituals: case studies from colonial Eten, Lambayeque, Peru.

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A central challenge in bioarchaeology today involves greater integration of physical anthropologists in the field excavation of human remains. This is especially true considering the growing awareness of the field methodology of archaeoethnology and its potential to contribute to reconstructions of burial patterns, paleopathology, and other biocultural dimensions of the past. In this poster, we examine two case studies of highly unusual mortuary treatments of ethnically Muchik children in the Early Colonial mission church established in the seaside settlement of Eten, north coast Peru. We hypothesize that seated and flexed children, one of whom was buried inverted, represented some kind "deviant burial" during a period of unprecedented social tension and conflict. Via the archaeoethnological approach, strict anatomical in situ observation, documentation, and analysis of bone positioning and taphonomy reconstructs these potential bundle burials, and shows they are no different than any late pre-Hispanic burial of the same seated-flexed or even inverted positioning. Also, bioarchaeological data pertaining to population patterning of acute and chronic childhood stress, growth, and nutrition only reveal the rather unremarkable life histories and deaths of these children. Application of anatomical and skeletal biological information allows us to reject the hypothesis. Instead, these atypical interments probably reflect an early and rapidly terminated expression of religious syncretism during the Early Colonial encounter in Eten. In terms of methods, this work highlights the value of anatomical excavation and observation of human skeletal remains and the cross-disciplinary potentials of further integrating physical anthropology and field archaeology.

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7392), Utah Valley University's Grants For Engaged Learning (2010), the Phased Grants Program (2011), Research Fellowship Program (2011), Presidential Scholarship Awards (2010), the Scholarly Creative Opportunities Program, (2009-11), and the College of Humanities and Social Science's Dean's Office (2010, 2011).

Gross characteristics and microscopic architecture of the vervet monkey (*Chlorocebus sabaeus*) placenta: Implications for anthropoid primate brain growth.

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Little is known about placental growth and morphology across gestation in nonhuman primates. A rare time-series of 50 vervet monkey (*Chlorocebus sabaeus*) placentas from the St. Kitts Biomedical Research Foundation was characterized in terms of gross morphology and shifts in efficiency across the latter half of a species-typical 167-day gestation. Although both fetal mass and placental mass increased significantly with gestational age (Pearson's correlations: $r=0.85$, $p<0.001$; $r=0.64$, $p<0.01$, respectively), growth was not symmetrical. Placental efficiency during period 2 (d. 131-159) was 43% greater than that of period 1 (d. 83-130) (T-test: $t=-3.60$, $p<0.001$), with placental mass accrual slowing at day 130 while fetal mass continued to increase. This suggests there is an important shift in the metabolic capacity of the placenta, perhaps in relation to investment in developmental events such as brain growth. This slowing of gross increases in placental mass is coupled with an expansion of the microscopic surface area of the villi with associated increases in topographical complexity, a mechanism by which nutrient and oxygen exchange increases to support the energetic burden of late gestation brain and somatic growth. A better understanding of how the placenta drives and constrains fetal and brain growth in anthropoid primates is directly relevant to developmental models of human brain evolution.

This study was directly funded by an American Association of Physical Anthropologists Career Development Grant and a Building Interdisciplinary Research Careers in Women's Health (BIRCWH) faculty scholarship from the National Institute of Child Health and Human Development and the National Institutes of Health Office of Research on Women's Health (K12HD055892).

Evaluating the impact of inter-taxon sample size variation on fossil hominin phylogenetics.

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Different species are often represented by different numbers of specimens in fossil hominin phylogenetic studies. The potential impact of this variability on the reliability of the resulting phylogenies has been highlighted recently. Using simulated data, Hawks (2004) found that only 12% of the true trees were the shortest when sample sizes varied among taxa. He argued that character states were erroneously assigned to taxa with small sample sizes and that this resulted in many autapomorphies. Given the importance of a reliable fossil hominin phylogeny for paleoanthropology, there is a need to investigate this issue further.

This study evaluated the impact of heterogeneous sample sizes on phylogenetic reconstruction using craniodental data from extant hominoids and two outgroup taxa. Taxa were randomly assigned sample sizes ranging from the maximum per taxon to three individuals. The size-corrected data were then converted to discrete character states using divergence coding. Next, maximum parsimony and bootstrap analyses were conducted in PAUP*. Lastly, to assess the impact of sample size heterogeneity, trees yielded by the heterogeneous samples were compared with the trees obtained when homogeneous sample sizes were used.

The main effect of sample size heterogeneity was an increase in the number of unresolved clades. This was due to taxa with smaller samples often being found to be statistically indistinguishable from taxa with larger samples in the character coding phase, and therefore being assigned the same character state. Thus, heterogeneous sample sizes likely negatively impact fossil hominin phylogenies but not in a manner suggested by Hawks (2004).

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Paleodietary implications of the Pliopithecidae from dental microwear and relative enamel thickness of two Iberian taxa.

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The pliopithecid subfamilies Pliopithecinae and Crouzeliinae differ in tooth occlusal details, with the latter displaying sharper crests and more compressed cusps. Such differences have been traditionally interpreted as indicating higher levels of folivory in crouzeliines. We review paleodietary evolution in pliopithecids, by further providing new data on dental microwear (DM) analysis and 2D relative enamel thickness (RET) for two Iberian pliopithecids: *Pliopithecus canmatensis* from Abocador de Can Mata locality ACM/CS-A8 (MN8, 11.7 Ma); and Crouzeliinae gen. nov. from Castell de Barberà (CB; MN8 or MN9, ca. 11.2-10.5 Ma). The latter is interpreted as a basal crouzeliine sharing dental synapomorphies with

Anapithecus, but having evolved from a pliopithecine ancestor similar to *P. canmatensis*. DM indicates that pliopithecids were intermediate between extant frugivores and hard-object feeders. In particular, discriminant analyses classify *P. canmatensis* and other pliopithecines as hard-object feeders, whereas the CB taxon and *Anapithecus* are classified as frugivores with some sclerocarpic component. The two Iberian taxa displayed a thin-enameled (RET<11.31) condition, and may be inferred to have exhibited a significant folivorous component. DM results are somewhat at odds with this thin-enameled condition, which a priori would be more suitable for frugivory, suggesting that RET is highly influenced by phylogenetic constraints. We therefore interpret results as indicating a more sclerocarpic component for pliopithecids than previously reported. Overall, this suggests that crouzeliine evolution might be related to decreased sclerocarpy instead of increased folivory. However, further research is required for assessing the role of dietary niche partitioning during the Miocene radiation of the Pliopithecidae.

This work has been supported by the Generalitat de Catalunya (2009 SGR 754 GRC), and the Spanish Ministerio de Ciencia e Innovación (CGL2008-00325/BTE, CGL2010-21672/BTE and RYC-2009-04533 to DMA).

Patterns of morphological integration in the brain in infants with craniosynostosis.

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The complex structure of the vertebrate brain develops intimately and in concert with the overlying skull, with each influencing the other. Morphological integration (MI) is the quantitative study of patterns of developmental interactions among parts of an organism. It has been posited that perturbations of development lead to decreased measures of MI. Craniosynostosis is defined by premature fusion of cranial sutures, and is associated with craniofacial dysmorphology. Here we test the hypothesis that altered development of the head in infants with craniosynostosis will be reflected in decreased magnitudes of MI of the brain as compared to the brain in typically-developing infants.

Our sample consists of magnetic resonance images of 10 infants with sagittal synostosis (SS) and 10 age-matched unaffected (UA) infants. We manually segmented 3D surfaces of the brain from the MRIs using Amira 5.2©. We then collected 3D landmark coordinate data from these surfaces using etdips©. Patterns of morphological integration in the brain between SS and UA infants were statistically compared using MIBoot© software. Our results show that, in general, the magnitude of MI is

similar in the two groups of infants. However, there are localized patterns of statistically significant differences in MI. These patterns include decreased integration in the association of measures of the frontal lobe with the location of the anterior temporal lobe. These results suggest that alterations of skull development are associated with changes in the patterns of development of the underlying brain.

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The primitive aspects of the foot and ankle of *Australopithecus sediba*.

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Foot fossils from the 1.977 myr Malapa site, South Africa display a unique mixture of primitive and derived morphologies. The foot and ankle fossils of *Australopithecus sediba* now include distal tibiae, a distal fibula, talus, calcanei, navicular, lateral cuneiform, several partial metatarsals, and a distal phalanx. Its calcaneal tuber is gracile, and lacks the weight-bearing lateral plantar process found in fossils attributed to *Au. afarensis*, making it surprisingly (given the bipedal advances in other parts of the *Au. sediba* skeletons) more ape-like than a hominin over one-million years its elder. The medial plantar process projects in a beaklike fashion, suggesting a strong role for flexor digitorum brevis, an important muscle for pedal grasping. The talar head is disproportionately large, implying some mobility at the talonavicular joint. The lateral cuneiform is proximodistally short, unlike the elongated tarsal region found in the foot of humans and other australopithecines. Unlike the condition in humans, or in any known fossil hominin, the base of the fourth metatarsal is slightly convex, indicating some mobility at the tarsometatarsal joint. These morphologies suggest that *Au. sediba* had a more mobile midfoot than that of any known *Australopithecus*. The small heel process and the mobile midfoot region both suggest that *Au. sediba*, while bipedal, practiced kinematically different upright walking than modern humans and other bipedal hominins. The thickness of the medial malleolus, beaklike projection of the medial plantar process, and midfoot laxity indicate that *Au. sediba* was probably arboreal, and perhaps the most arboreal of the australopithecines.

Femoral bone growth and the relationship with stable isotope values: Preliminary results.

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Differences in the way that bone processes nitrogen and carbon may reveal something about bone growth. Long bone growth in modern human adults can vary from the inner cortex nearest the medullary cavity to the outer cortical bone layer. One influence on bone growth in adulthood is activity and in archaeological samples this can be inferred from bone robusticity. This study compares isotope values from the inner and outer bone cortex in an archaeological sample of modern humans. The age-matched male humans were subdivided into two groups, gracile and robust ($n=4$), based upon cortical thickness measurements and muscle markings.

Femoral bone samples were taken from the inner cortex near the medullary cavity and the outer cortical layer, near the outer surface. Standard isotopic methods based on a modified Login 1981 method were used. Preliminary results show that robust and gracile individuals have a similar percentage of carbon and nitrogen in the inner cortex. However, there is a greater percentage of nitrogen and carbon in the outer layer of the robust individuals (%N = 11.7; %C = 37.2) compared to the gracile individuals (%N = 9.7%; %C = 29.3). Results are discussed in terms of sampling protocol for isotope studies and the uptake of carbon and nitrogen in bone.

Ecological and behavioral analyses of the *Cercopithecus* hybrid population at Gombe National Park, Tanzania.

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Hybridization events that produce viable and fertile hybrids have the potential to alter the evolutionary trajectories of the parental species, as well as lead to the formation of new recombinant lineages. Among extant primates, sympatric hybridization is rare, and the best-known cases occur among the arboreal *Cercopithecus* monkeys of the guenon radiation. Gombe National Park in Tanzania is the only known persistent hybrid zone between two well-differentiated and ecologically distinct primate species. The Gombe guenon population (*Cercopithecus mitis*, *C. ascanius* and their hybrids) thus provides a rare opportunity to study ecological and behavioral dynamics of a hybrid primate population.

I conducted a 12-month field study of Gombe's guenon population. I used a combination of line-transect survey methods and focal group follows to estimate abundance of hybrid monkeys and the two parental populations. I recorded GPS positions of all sightings to examine distribution patterns within the entire park. I recorded group composition data and all reproductive behaviors observed. Survey results indicate 15.2% of the monkeys counted were hybrid, 30.4% were *C. mitis*, and 54.5% were *C. ascanius*. Hybrid monkey density was highest in the southern half of the park. Females and males of each phenotype mated with conspecifics, heterospecifics and hybrids.

Heterospecific and hybrid monkeys engaged in affiliative, contact calling, and intergroup territorial behaviors typical of conspecific members of the same social group. These behavioral observations confirmed that mixed-phenotype groups (groups having blue, red-tailed and hybrid adult females) are a behaviorally defined social group type occurring at Gombe.

The contribution of forensic anthropology to national identity in Chile: a case study from the Patio 29 mass grave.

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The military coup of September 11, 1973 saw the arrest, detainment and slaughter of thousands of supporters of the socialist political party led by Presidente Salvador Allende. Bodies of tortured and executed individuals were often left floating in the Mopoché River and illegally buried in unmarked graves in Santiago's Cemeterio General at a site called Patio 29. The graves were exhumed during the 1990's but the patio still serves as a memorial to the "disappeared" of the Pinochet regime. The impact of the conflict in Chile will be outlined while presenting a case study from the Patio 29 grave site. The process by which human remains from Patio 29 have transformed the legal and social systems of Chile will be explored during the discussion of an individual whose remains were recovered and examined during the original 1990's exhumation and again in 2010. Additionally, this presentation will highlight the impact of the Patio 29 exhumation on the subsequent formation of a full-time forensic anthropology team specifically designed to handle human rights caseloads. It will also discuss how the forensic and anthropological sciences used in human identification are agents of change in response to the human rights movement in the Chilean post-war era. The resultant impact has spurred a comprehensive examination of the military regime and atrocities committed in the 1970's in an attempt to illuminate and restore public faith and pride in national identity.

Are you what your mom ate? A model for developmental programming of human osteoporosis and obesity.

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Maternal overnutrition increases the risk of postnatal metabolic disease via perinatal developmental programming. Here we test the hypothesis that maternal diet induces skeletal programming that alters offspring skeletal acquisition. **Methods:** C57Bl/6J mothers were fed high-fat (HF, 45% fat) or normal (N, 10% fat) diet from 6 wks before breeding through

gestation and lactation. At 3 wks of age we weaned male and female pups onto high-fat (HF-HF or N-HF) or normal diet (N-N). Outcomes at 12 and 20 wks of age included body mass, body fat, mass-adjusted bone mineral content (BMC/BM), and cortical and trabecular bone architecture at midshaft and distal femur. **Results:** HF diet caused obesity, with HF-HF more obese than N-HF ($p<0.05$), and impaired skeletal acquisition vs. N-N. By 20 wks of age, HF-HF had 20% lower mass-adjusted BMC and 36-50% higher body fat vs. N-N ($p<0.05$). N-HF had lower distal femur trabecular bone volume fraction (BV/TV) vs. N-N ($p<0.05$). In females, trabecular BV/TV was lower in HF-HF vs. N-HF; in males, it was higher. Midshaft femur cortical bone area was lower in N-HF and higher in HF-HF vs. N-N ($p<0.05$). **Conclusions:** Postnatal HF diet impaired bone mineral content and trabecular bone acquisition in both sexes. Maternal HF diet protected offspring cortical bone, and trabecular bone in males, from these effects, but worsened the effects of postnatal HF diet on trabecular bone in females. These data suggest that maternal diet may alter human skeletal phenotype and osteoporosis risk via developmental programming.

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Mapping moose: moose as a proxy for humans in the mapping of stable isotopes for forensic purposes.

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According to a 2004 survey of medical examiner/coroner offices across the United States there were almost 13,500 sets of unidentified human remains across the nation. An additional 4,400 cases are reported annually with 1,000 of these remaining unidentified after a year, creating a compounding problem. Stable isotope analyses can serve as a first line of inquiry to narrow down the possible region of origin of skeletal remains. The analysis of the variation between the isotope ratios of oxygen ($^{18}\text{O}/^{16}\text{O}$) is of particular value for this purpose as local water resources determine body $\delta^{18}\text{O}$ values that should remain predictable for local fauna and humans. This study fills a void in the isotopic record of interior Alaska by providing an updated predictive $\delta^{18}\text{O}$ model of Alaskan drinking water ($\delta^{18}\text{O}_{\text{water}}$) and a predictive $\delta^{18}\text{O}$ model for Alaskan moose ($\delta^{18}\text{O}_{\text{moose}}$). Thirty-two moose mandibles were acquired from the Alaska Department of Fish and Game and one incisor was extracted from each mandible. $\delta^{18}\text{O}$ values were obtained from the enamel. A GIS predictive model of Alaska including water and plant $\delta^{18}\text{O}$ values as well as ecologic, climate, and geographic information was developed. A statewide $\delta^{18}\text{O}_{\text{water}}$ predictive surface was then created. This surface was used in conjunction with sampled $\delta^{18}\text{O}_{\text{moose}}$ values to create a statewide $\delta^{18}\text{O}_{\text{moose}}$ predictive surface. These predictive models may in turn be useful for identifying geographic origin of human remains in forensic cases because both $\delta^{18}\text{O}_{\text{moose}}$ and $\delta^{18}\text{O}_{\text{human}}$ values should approximate the local $\delta^{18}\text{O}_{\text{water}}$ values with similar fractionation effects.

Medieval famine and health: skeletal markers of childhood physiological stress in survivors of the Great Famine, 1315-1322.

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Fourteenth-century European populations suffered from a series of famines and disease epidemics, most notably the Great Famine of 1315-1322 and the Black Death of 1347-1351, which together killed tens of millions of people. Researchers have argued that famine contributed to generally poor levels of health in medieval populations and thereby to the devastating effects of the Black Death. This study examines whether the Great Famine had discernible effects on the health of people in London by analyzing skeletal pathologies in people who survived the famine but later succumbed to the Black Death. Data for this study come from the East Smithfield cemetery, London, an exclusively Black Death cemetery that was used only during the epidemic in London from 1349-1350. The East Smithfield cemetery provides an almost unequalled opportunity to study individuals who died within a short period of time from a single cause of death. This paper uses a sample of 240 people from East Smithfield, and compares the frequencies of enamel hypoplasia and cribra orbitalia between individuals who were at risk of forming such lesions (i.e., were approximately 0-12 years old) during the Great Famine and those who would have been either too old or too young to develop the lesions during that same period. The results show no significant difference in the frequency of cribra orbitalia between the "famine" and "non-famine" groups, but a significantly lower frequency of enamel hypoplasia in the "famine" group. These results might reflect the effects of selective mortality during the Great Famine.

Data for this study come from projects funded by the National Science Foundation (BCS-0406252) and the Wenner-Gren Foundation (#7142).

Building an ecosystem of data: expanding the Open Research Scan Archive (ORSA) through institutional collaboration.

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Now that ORSA has achieved a critical mass of CT scans and researcher interest, we are exploring ways of developing it to facilitate data integration and data portability. Rapid expansion in the use of Linked Data protocols by museums and archives are paving the way for new possibilities in data collection and dissemination. ORSA has the potential to forge new

connections to data sources beyond biological anthropology.

ORSA

(<http://plum.museum.upenn.edu/~orsa/Welcome.html>) was created in 2002. Since then the archive has grown to include over 1800 crania and over 4000 CT scans. ORSA (formerly: Penn Cranial CT Database) has distributed these scans to more than 100 scholars and students all over the world. In 2008 the Penn Museum reached out to the Mütter Museum of The College of Physicians of Philadelphia in an effort to expand the scope of the archive beyond the Penn owned material. The Mütter Museum is home to the Hyrtl Skull Collection, which comprises 138 known individuals, collected by Joseph Hyrtl, MD in the mid-19th century. The Academy of Natural Sciences and The American Philosophical Society have also contributed to the collections data. Access to the archive is free and open to the public and researchers may request high resolution scans.

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Phylogenetic position of the yellow-tailed woolly monkey based on whole mitochondrial genomes.

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The yellow-tailed woolly monkey, *Lagothrix flavicauda*, is an atelid primate endemic to montane forests in northern Perú and has long been considered critically endangered. In recent years, its phylogenetic position and taxonomic status have been controversial. While an early comprehensive review (Fooden 1963) considered the yellow-tailed woolly monkey as one of two allopatric species of *Lagothrix*, a cladistic analysis of craniodental characters (Groves 2001) elevated the taxon to its own monotypic genus, under the resurrected name *Oreonax*, and considered it a sister taxon to spider monkeys (*Ateles*) rather than *Lagothrix*. However, a recent reanalysis argued that the craniodental evidence is insufficient to warrant assigning this primate to a distinct genus (Rosenberger and Matthews 2008), and other morphometric studies have confirmed a closer relationship between *L. flavicauda* and other woolly monkeys instead of *Ateles* (e.g., Paredes 2003).

Using complete mitochondrial genome sequences, we provide the first molecular phylogenetic analysis of the position of yellow-tailed woolly monkeys. Bayesian, likelihood, and parsimony analyses all support a monophyletic *Lagothrix* that includes *L. flavicauda*.

Additionally, sequence data from the mtDNA COII region show that genetic distances between *L. flavicauda* and other *Lagothrix* from across the genus' geographic distribution fall within the range of between-species divergences seen in both *Alouatta* and *Ateles* at the same locus. Our results confirm a position for the yellow-tailed woolly monkey within *Lagothrix*, recommending that *Oreonax* be formally considered a synonym. This revision in taxonomic status does not change the dire conservation threats facing this primate in Perú.

This project was supported by New York University and the New York Consortium in Evolutionary Primatology

Effects of anthropogenic habitat disturbance on the distribution of the diurnal primate community in northwestern Bolivia: using census and remote sensing techniques.

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In this study I examined population densities and habitat preferences of the primate community in northwestern Bolivia at Camp Callimico. I surveyed the diurnal primate community between June and July 2011 on 8 km of transects which I walked at 1/km hour. For each group of species sighted, I recorded its location, size, composition, and activity, as well as the height of the first individual sighted, and the habitat it occupied. In addition, I established 45, 10 m² botanical plots located at 100 m intervals along transects. I recorded the DBH, crown size of trees, as well as the number of stems of all vegetation in plots. I observed 10 species of diurnal primates, of these *Saguinus fuscicollis* had the highest density (25.1 individuals/km²) and *Callimico goeldii* had the lowest density (3.3/km²). Primary, secondary, and edge habitats were the most abundant along transects and the majority of primates were found in primary habitat. Disturbed and edge habitats created by human activity had fewer primates than primary habitats, but more primates than other habitats along transects. Results demonstrate that primary forests in this area support larger populations of primates than disturbed habitats, but that some species are still common in areas with anthropogenic disturbances. DEMS (Digital Elevation Models) of northwestern Bolivia from previous years were compared with current satellite imagery using remote sensing to create predictive models for species distribution and richness in this region. These results are important for understanding the effects of anthropogenic habitat disturbance on wild primate communities.

This study was funded by the Fresno Chaffee Zoo, and the Department of Anthropology and Center for Latino and Latin American Studies at Northern Illinois University.

Promiscuous mating with an aggregation of males by a female black handed spider monkey (*Ateles geoffroyi*) in northern Belize.

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An unusual mating sequence was observed for black handed spider monkeys in a wild population at La Milpa, northern Belize. Mating in free-ranging and wild populations of the black handed spider monkey (*Ateles geoffroyi*) usually occurs in private, with the couple separated from the social group, in a dorso-ventral position, and lasts 17 minutes (Campbell 2005).

On March 23, 2011 we observed a large group of spider monkeys (at least 15 individuals) traveling and feeding. After approximately 15 minutes of feeding, an aggregation of males suddenly formed around a female. At least six male spider monkeys attempted to mate with the female in quick succession. They were hanging and attempting ventral-ventral mating. Each male appeared to spend approximately 5 minutes in potential mating position, but copulation could not be verified. Males were not aggressive with each other, but did hang onto one another, causing each other to drop to lower branches from which they would quickly climb back up to the female. The female did not vocalize or attempt to run away, as was observed during the forced copulation of spider monkey female in the wild (Gibson et al. 2008). Instead the female seemed to be receptive to the aggregation of males.

Similar mating aggregations were previously observed for woolly spider monkeys (*Brachyteles arachnoides*), the females of which copulated with multiple males in quick succession, with no copulation lasting longer than 4 minutes (Milton 1985). Implications for potential sperm competition between male spider monkeys are discussed.

Population continuity or replacement at ancient Lachish? A dental affinity analysis in the Levant.

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Are material culture changes between late Bronze and early Iron Age inhabitants of Lachish, in modern day Israel, the result of immigrants settling the region, or an in situ evolution of practices by the same indigenous peoples? The research objectives are to: 1) assess dental affinity of an Iron Age Lachish sample relative to its Bronze Age predecessor, and 2) compare data in both groups with European and North African comparative samples to estimate biological affinity within the Mediterranean area. In the process, two competing hypotheses are tested; one postulates continuity and the other population replacement between the Bronze and Iron Age. Using the Arizona State University Dental Anthropology System, up to 36 non-metric permanent crown, root, and osseous trait frequencies were compared using the mean measure of divergence statistic to determine inter-sample phenetic affinities. In support of

previous work, the results suggest: 1) biological continuity between the Lachish Bronze and Iron Ages, and 2) overall affinity to North African and European populations within the Mediterranean Diaspora – based on samples of various age from Giza, Carthage, Greece, Italy, Algeria, and Turkey, among others. These findings expand upon previous work by using a much larger number of traits and comparative samples; they also lend support to one of many competing theories identifying the ancient Lachish peoples, while providing an increased understanding of the Bronze and Iron Age transition in the Levant. This transition is often considered one of the most intriguing and volatile periods in the Near East.

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Paternal infanticide in the socially monogamous Bolivian gray titi monkey, *Callicebus donacophilus*.

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A paternal infanticide was observed in a group of unprovisioned Bolivian gray titi monkeys, *Callicebus donacophilus* in Santa Cruz, Bolivia. An approximately 3 week old male infant was killed by a conspecific male. Both the mother and subadult male in the group tried, without success, to protect the infant. While risk of infanticide has been promoted as a key factor for the evolution and maintenance of monogamous social systems, there has been little direct evidence. This is the first observed case of paternal infanticide in the genus *Callicebus*. A genus recognized as being among the most socially monogamous of all primate species. Various reasons why infanticide is expected in this genus are discussed.

Stature and speed estimates for 1.5 million-year-old fossil footprints at Ileret, Kenya based on gait analyses of unshod Daasanach.

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Fossil footprints, though rare in the fossil record, provide the only direct evidence of bipedal gait in extinct hominins. The recent discovery of 1.5 million-year-old hominin footprints from multiple horizons in Ileret, Kenya improve this sparse record, but a limited understanding of the relationship between pedal

anatomy, gait, speed, and footprint morphology inhibits our ability to interpret hominin print assemblages. In this project, controlled experiments with habitually unshod and minimally shod Daasanach men (n=19) and women (n=19) from Ileret were conducted to clarify and quantify these relationships.

Biometric data were collected on each subject. Subjects were then filmed while traveling at a range of qualitatively defined speeds across an open-ended trackway that contained a patch of rehydrated sediment from the hominin print layer. 2D kinematic data were collected using Peak Motus and ImageJ. Regression analyses show significant relationships between dimensionless stride length and speed across the full range of speeds ($r^2=0.91$, $p<0.001$), as well as across the walking speeds ($r^2=0.82$, $p<0.001$) and running speeds ($r^2=0.77$, $p<0.001$) when analyzed separately. Using the experimentally derived regression equation, we provide estimates of the travel speeds inferred from the fossil print trails, which range from 0.23 m/s to 2.2 m/s. If the 1.5 million-year-old hominins had foot length:stature proportions equivalent to those of the modern Daasanach, the fossil footprints of multiple individuals show evidence of large stature (>150 cm), suggesting that these prints were created by *H. erectus* or male *P. boisei* individuals.

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Comparative anatomy, evolutionary trends and the myth of human morphological complexity: empirical studies reveal that modern humans have fewer muscles than most primate and non-primate mammals.

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We undertook gross anatomical dissections of the soft tissues of various individuals from each major primate clade (total N = 55). The results obtained from these dissections and from our cladistic analyses may seem paradoxical. On the one hand the cladistic analyses suggest there is a higher number of unambiguous evolutionary steps [NS] from the base of the tree to modern humans than to any other taxon included in the study. Yet our anatomical studies reveal that modern humans have fewer muscles than most other mammals and than most primates, in particular many fewer than in strepsirrhine and tarsiiform primates. For instance, *Nycticebus* has a NS of 30 and a range of 133-139 head, neck, pectoral and upper limb muscles in total, while modern humans have an NS of 75 but only 123 muscles in total and chimpanzees have an NS of 70, but have 3 more muscles than modern humans in total. The solution to this apparent paradox lies on Stephen J. Gould's contention that the importance given to 'evolutionary trends' and particularly to the supposed examples of human remarkable morphological complexity is best explained by

the historical under-reporting of examples of undirected evolution and of morphological 'simplification'. That is, despite accumulating more evolutionary transitions than other primates, these transitions did not result in modern humans having more muscles or bundles per muscle, e.g., since the *Pan/Homo* split humans have actually secondarily lost muscles (e.g., levator clavicularae and dorsoepitrochlearis) that are present in most other primates.

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Co-evolution of facial expressivity and cooperation in catarrhine primates.

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Psychologists have suggested that facial expressivity is signal of trustworthiness in humans. This is based on the observation that people are more likely to cooperate with individuals that readily produce facial displays. The "trustworthy face hypothesis" implies that facial expressivity evolved in correlation with cooperative behaviors. To test this hypothesis in catarrhines, I examined the co-evolution of facial motor control and social grooming, which is an example of reciprocal altruism.

Data were gathered from the literature ($N = 10$) and analyzed using phylogenetic GLS regression. The dependent variable was facial nucleus volume, which is a proxy for facial motor control. Medulla volume, social grooming time, and population group size were predictors. Social grooming time was a significant predictor of facial nucleus volume independent of medulla volume ($b = 0.21$, $t = 2.65$, $p < 0.05$). In contrast, the effect of group size on facial nucleus volume did not reach statistical significance after controlling for medulla volume ($b = 0.14$, $t = 1.74$, $p = 0.07$). When both social grooming time and group size were included as predictors in the same model, neither variable reached statistical significance, but the effect of grooming time was stronger than group size (social grooming: $b = 0.22$, $t = 1.55$, $p = 0.18$; group size: $b = -0.01$, $t = -0.08$, $p = 0.94$).

The results of this study provide comparative support for the trustworthy face hypothesis. The importance of facial expressivity in cooperative interactions might be a productive area of future research in behavioral primatology.

The utility of osteon shape and circularity for differentiating human and nonhuman Haversian bone.

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Distinguishing human from nonhuman bone fragments is usually accomplished by observation of gross morphology. When macroscopic analysis is insufficient, histological

approaches can be applied. Certain microscopic traits, such as the presence of plexiform bone or osteon banding, are characteristic of nonhuman bone. In the absence of such features, however, distinguishing Haversian bone as either human or nonhuman proves problematic. This study proposes a histomorphometric approach for classifying human from nonhuman samples using Haversian bone.

Two variables, osteon area (On.Ar.) and circularity (On.Cr.), are examined. Measurements were collected from a sample of three species (deer, dog, human) represented by various skeletal elements (ribs, humeri, femora). ANOVAs and discriminant function analysis (DFA) were used to analyze data. Results demonstrated no significant difference across long bone anatomical quadrants and only minor variation in On.Cr. within the nonhuman sample across elements. DFA run on the variable means for each sample demonstrated clear overlap in deer and dog samples, clustering the nonhuman and human groups apart from each other. Mean On.Cr. proved a poor criterion, while mean On.Ar. proved useful in identifying human from nonhuman samples. When both variables were combined, accuracy increased to 100% correct classification for data from the ribs only and 98.4% when considering all elements. Similar results were obtained when DFA was run on individual osteon measurements. This indicates that the measurements of On.Ar. and On.Cr. are valuable histomorphometric tools for distinguishing human from nonhuman Haversian bone, even when the skeletal element is unknown and the number of measurable osteons limited.

Life history of wild western gorillas (*Gorilla gorilla*): new data and cross-site comparisons indicate gorillas do not grow and reproduce as fast as you think.

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Comparative life history studies typically indicate that gorillas grow and reproduce more quickly than do other great apes, although this conclusion is primarily based on data from captivity and a single (Karisoke) population of eastern gorillas (*Gorilla beringei*) that reside where high-quality food is abundant. Since growth and reproduction are strongly influenced by nutrition, gorillas in habitats with less food may mature and reproduce more slowly. Here we document growth and reproduction in wild western gorillas at the Mondika Research Center, Republic of Congo. We followed one group on a nearly daily basis between 2002-2011, recording all births, deaths, immigrations and emigrations, and for a more restricted time period, all copulations and nipple contact to determine gestation and weaning age respectively. Although gestation lengths were comparable at both sites, at Mondika, gorillas weaned 33% later, inter birth intervals (following a surviving offspring) were 35% longer, and female age at natal transfer and first reproduction was 1.3

years later than at Karisoke. These results, together with data from three other gorilla sites, indicate considerable variation in gorilla growth and reproduction, with all gorilla populations, except Karisoke, growing and reproducing at a much slower pace than commonly assumed.

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Assessing farm risk to crop damage by vervet monkeys (*Chlorocebus aethiops*) in St. Kitts, West Indies.

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Despite 300 years of crop damage by vervet monkeys in St. Kitts, nothing is known about their raiding behavior or the effect it has on farmers. In this study, one-third of the farms ($n = 65$) registered with the department of agriculture were randomly selected for 12 sequential months of crop damage monitoring. To determine the risk of crop damage, crops were mapped monthly using a GPS and all crop damage was quantified. Here, I evaluate the impact of four environmental variables on farm risk: distance to forest boundary, distance to water sources, number of neighboring farms and guarding behavior. During the year, monkeys destroyed 4,853 pounds of ground crops and 7,860 above ground crops on 52% of farms. Crop damage is positively correlated with distance to forest boundary ($r = 0.289$; $p = 0.021$), distance to water sources ($r = 0.247$; $p = 0.049$) and guarding behavior ($r = 0.245$; $p = 0.051$) and negatively correlated with more neighboring farms ($r = -0.377$; $p = 0.002$). A multiple regression analysis reveals that the number of neighboring farms ($\beta = 0.251$; $p = .003$) followed by distance to water sources ($\beta = -0.27413$; $p = 0.075$) contribute most to variability in crop damage (overall model $r^2 = 18.6\%$). In addition, significantly less crop damage occurs during the mango season (T-value = 5.62; $p = 0.001$). These results, combined with interview data, will be used to develop a management strategy that protects high-risk farms and incorporates the concerns of local farmers.

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Within population variation: postnatal dental development in the Southeastern US.

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Human dental calcification, or the process in which teeth mineralize within the alveolar portions of the maxilla and mandible, is primarily regulated by genes and is relatively buffered against environmental influences that may otherwise impact skeletal growth and development. Though the patterning of dental development is generally the same in all humans,

it is often debated to what extent the timing and tempo of dental development may vary among populations. The purpose of this research is to apply Bayesian analyses in order to assess to what extent the timing of dental development may vary between contemporary populations of the Southeastern United States.

For this study, 59 panoramic radiographs of individuals from a contemporary Florida population ranging in age from 7.7-20.4 years were reviewed. Dental development stages were scored utilizing standards devised by Moorrees et al. (1963). Statistical analyses incorporated methods in Bayesian analysis, such as transition analyses, and a cumulative probit model on the log scale ages. The timing of dental development was compared to that of a contemporary Middle Tennessee Population provided by Harris and McKee. Results of this study indicated that 20 of the 59 cases fell within the predicted age limits, and that there is a consistent underestimation of age for the Florida population when the Middle Tennessee population is utilized as an informed prior. This difference in the timing of dental development between the contemporary US populations is attributed to within population variation, and is useful in creating accurate age estimation standards for unknown individuals.

Bad luck, or bad intentions? Interpreting fractures from an early 20th century pauper cemetery.

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Interpersonal violence is a recurring topic of interest for archaeologists and physical anthropologists alike. Looking to clinical literature for guidance, researchers have attempted to identify specific skeletal elements most frequently damaged through interpersonal violence. This has invariably led to an anatomically regionalized injury dichotomy in which cranial fractures signify violent injury, while post-cranial fractures are produced by accidents. Parry-fractures of the ulna are the usual exception to this rule, but recent research includes the hands and ribs in the suite of violence-related fracture loci. In an effort to explore the presence of violence among an historic skeletal population, 985 skeletons from the Milwaukee County Institutional Grounds Cemetery were examined for fractures and other traumata. Two hundred forty-seven individuals had fractures. One hundred twenty-three fractures affected skeletal elements commonly associated with violent injury, such as the skull and hand. Forty individuals exhibited healed cranial fractures, with the vast majority affecting the nasals. It is overtly tempting to interpret the presence of such fractures as the outcome of violent interactions. However, observed patterns of multiple traumata make such an interpretation tenuous. In addition, historical evidence drawn from archival and contemporaneous clinical sources suggests that the circumstances through which such injuries could be received were highly variable, and need not be uniformly the result of interpersonal violence. Thus, while some fractures may have been caused by bad intentions, one cannot discount the simple possibility of bad luck.

Remodeling in bones of the human hand and its relationship to loading.

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Animal studies have shown that intracortical remodeling is a mechanism that repairs microfractures, which occur naturally in loaded bones. This has been difficult to test in humans because other factors, such as genetics and diet for example, modulate remodeling and are variable among individuals. In order to control for these factors, we compare modeling and remodeling on paired right and left second metacarpals of humans (n=49). We test the hypothesis that the side incurring greater loads will also be characterized by more remodeling. Second moments of area (I_{max} , I_{min} , I_{ap} , I_{ml}) and the polar moment of inertia (J) were measured. Osteon population density (OPD) was measured on the anterior, posterior, lateral and medial quadrants. Results for right and left bones are compared with paired t-tests. Relations between macro- and microscopic variables are tested with correlations between percent right-left differences. Right-left comparisons of macroscopic variables (I, J) are all significant, with the right side always being larger on average. However, all right-left comparisons of OPD are not significant. All correlations between the macroscopic variables and combined OPD are significant, but not in the expected direction. Correlations among macroscopic variables and the OPD of specific quadrants are significant only for the medial quadrant. Macroscopic values show that the metacarpals from the right hand incurred greater loads during growth, but, against expectations, there was less remodeling on that side. These results suggest that modeling-remodeling tradeoff mechanisms may be at play and caution is advised when using remodeling as an indicator of loading history.

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Secular change and the modern human pelvis.

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Secular changes in growth in the United States are well documented; this is also true for neonates. Full-term babies have exhibited a positive trend in birth weight, length, and head circumference. The question driving this research was whether the adult bony pelvis is changing in concert with the neonatal head. Likely, the modern morphology of the human pelvic girdle is a compromise between locomotion and parturition; has this form changed to accommodate successful birth?

The rearticulated bony pelvic girdles of individuals born between 1842 and 1981 were digitized for this study. Skeleton from the Hamann-Todd Osteological Collection, the Robert J. Terry Anatomical Skeletal Collection,

and the William M. Bass Donated Collection were used. Individuals were placed into five birth cohorts made up of equal numbers of black and white, male and female. 3D coordinates were collected and measurements calculated.

Geometric morphometry and traditional metrics indicated that the shape of the pelvis has changed. The pelvic canal is more rounded with significant increases in the inlet AP diameter and the outlet transverse diameter. Also, the subpubic angle is significantly larger in later birth cohorts. Females did not show corresponding increases in inlet transverse or outlet AP diameters. There is secular change occurring in the human bony pelvis. However, since the changes are consistent across ancestries and sexes, environmental improvement, such as nutrition, rather than parturition is likely the cause. Understanding the secular changes that alter the human pelvis will aid in deciphering how and why the current form exists.

Cultural modification of head shape among archaeological populations of the Western Chaco area, Argentina.

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Cultural cranial modification has been documented and studied on many ancient populations and it has been considered to be a marker of social status, gender, aesthetics and ethnicity. Certain anatomical consequences have been found to be consistent with intentional deformation of the skull, including an increase in the prevalence of wormian bones. This study evaluates the presence of intentional modification of head shape in human remains recovered from archaeological sites in the semiarid plains of the Western Chaco area, northern Argentina, during pre-Columbian times. The archaeological and chronological context of these prehistoric sites spans between IV to XVI AD. Sixty-five skulls, representing a period of 1200 years, were analyzed. Patterns of deformation were examined, including the morphological appearance of the deformed crania and their degrees of modification, as well as the incidence of this cultural practice among these ancient human groups.

The ample temporal range encompassed by the skeletal samples provides the opportunity to study the social dynamics concerning cranial vault modification among the pre-Columbian peoples that once inhabited the dry scrub forests of the Western Chaco before contact. It also represents an important and additional source of information regarding cultural connections and population mobility in the area. This study reveals that artificial cranial deformation exhibits a notorious prevalence and continuity through time, as the occipital or tabular erecta form of intentional deformation was predominant in this particular region during at least twelve centuries before the arrival of Europeans in northern Argentina.

Why does time spent gestating and lactating scale differently with body size across primates?

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Pregnancy (gestation) and nursing (lactation) are the two most costly phases of a female primate's reproductive cycle. In the first part of this study, we show that the time spent on these processes scales differently with body size across primates. Time spent in both phases increases with body size, but small mother monkeys (e.g., pygmy marmosets) spend more than twice as long gestating than lactating, while large mother apes (e.g., chimpanzees) do the reverse. This leads the allometric slope of gestation on body size to be much shallower than the allometric slope for lactation ($n=83$ species, phylogenetically-informed linear models, $p<0.0001$). In the second part of the study, we investigate why the allometric slope of gestation duration on body mass is so much lower than the allometric slope for lactation duration. We find intriguing comparative evidence that gestation duration across primates may be influenced by a general biomechanical (and therefore selective) constraint associated with locomotion: for a given body size, monkeys and apes that are more orthograde (upright) in their posture are pregnant for longer than monkeys and apes that are more pronograde (move about on all fours). If skeletal biomechanics constrain gestation length and hence neonate size and developmental state, longer compensatory lactation durations might be expected. If corroborated, this would be a general, non-human-specific explanation for the relatively short gestation and long lactation durations of many large primates.

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Archaeogenetics and paleodemographic estimation of founding populations, and features of residential geography on Rapa Nui (Easter Island).

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The development of improved techniques for extracting, amplifying and analyzing DNA from old or degraded tissue has provided unprecedented access to phylogenetic data for studying founding populations and the development of community structure in archaeology. Methodological advances in DNA extraction efficiency have resulted in increased throughput and have made large-scale sampling strategies viable, allowing the evaluation of anthropological and evolutionary hypotheses of mating and social behavior. Using mitochondrial and microsatellite data recovered from late prehistoric and early protohistoric (AD 1680 – 1750) skeletons from Rapa Nui ($n = 98$), we present evidence for genetic lineage construction

and emerging community structure under alternative models of colonization and demographic change. In this study, Rapa Nui mtDNA HVRI and HVRII sequence variation shows greater haplogroup variability compared to recent archaeological evidence from central east Polynesia (Deguilloux et al. 2011), supportive of a multiple colonization model. Microsatellite phylogenies suggest a refinement of previous craniometric (Stefan 1999) and archaeological (Dudgeon 2008) studies arguing that lineage endogamy and differential mobility of males and females is explained by the emergence of corporate tribal entities after AD 1500. Our results suggest that genetic affinity maps to geography and subsistence features, rather than simple isolation by distance models, and is characteristic of a socially diverse, infilled population landscape. We do not find supporting evidence for strict lineage endogamy reported in early ethnohistoric accounts, but rather limited and geographically patterned female endogamy, the details of which require further explanation within a framework of insular demographic expansion and emerging territoriality.

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Investigating cranial morphology of early, archaic and recent Native American samples: a preliminary alternative interpretation to the peopling of the Americas debate.

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Various metric studies of the earliest dated North American crania and recent Native American specimens imply that there is not substantial evidence for an ancestral relationship between these samples. However, recent genetic and paleogeological evidence offer alternative interpretations. This study tests the hypothesis that the differences in cranial morphology between early and recent Native American samples indicate a lack of descendent relationship. A sample of early North American crania were used and included male specimens from Plattsmouth Ossuary, Wet Gravel Pit, Lime Creek, Wizard's Beach, and Spirit Cave, as well as female samples from Plattsmouth Ossuary, Wet Gravel Pit, Gilder Mound, Buhl Cave and Gordon Creek. These specimens were compared to Archaic Native America crania and recent Native American samples (recent sample was obtained from the W.W. Howells Craniometric dataset).

A minimum number of measurements were utilized that would describe the cranial dimensions cited in the literature as representing the areas of most morphological difference in the early and recent Native samples. The variation in the combination of cranial measurements described was assessed by discriminant function analysis and calculation of Mahalanobis distances.

Results indicate that early crania exhibit variability. However, when these crania are compared to the Archaic and recent Native samples the differences observed are interpreted

as representative of gradual change. Conclusions of this study highlight the intermediate Archaic morphological trends, which provides characteristics that allow for the interpretation that the dissimilar morphology cited between the early and recent samples are emphasized by the vast temporal span.

Study on the lateral distribution in the expression of brain-specific proteins in the cerebral cortex in the common chimpanzee (*Pan troglodytes*).

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Despite the tremendous strides made toward the study of brain asymmetry and its behavioral correlates, there is still much to learn about microstructural and molecular lateralization of the cerebral cortex. It has been previously demonstrated that synaptophysin, a presynaptic vesicle-associated protein found in synapses of the central nervous system, is asymmetrically expressed in the primary motor cortex of the common chimpanzee (Sherwood et al. 2010). In the present study, we extend our investigation of asymmetry in protein expression levels, using Western blot analysis, by examining the interhemispheric distribution of other synapse-associated proteins, including synapsin 1, alpha-synuclein, PSD95, GRIN3a, SNAP25 and syntaxin 1 in the chimpanzee primary motor cortex. In addition, we investigate the pattern of asymmetry in synaptophysin expression ($N=4$) in the homologues of three cortical regions implicated in human speech and language, including BA44, BA45, and BA22. Preliminary results based on a maximum of 10 individuals where available indicate that the three presynaptic localized proteins, synaptophysin, synapsin 1 and alpha-synuclein have higher expression levels in the right hemisphere whereas no marked lateralized distribution in expression pattern was observed for the other investigated proteins. The functional implications of these asymmetries of cellular compartments still remain unclear and warrant further investigation.

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Using a regional approach to identifying aggressors in the archaeological record.

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Excavation and analysis of a mass grave at the Postclassic (AD 950-1524) Maya site of Zacpetén in Guatemala demonstrated that the grave was the product of a violent act. Identifying who created and who was interred in the grave was contingent on a regional approach. This presentation compares the Zacpetén mass grave to other relevant Postclassic mass graves in the Maya lowlands in light of osteological, archaeological, and ethnohistorical data. Ethnohistoric sources indicate that the site of Zacpetén fell within a social group named the Kowoj's territory prior to contact with the Spanish. Archaeological work has demonstrated that Kowoj occupation was marked in part by the presence of architectural assemblages with specific components and distinctive ceramic types. Mass graves are found in conjunction with these assemblages at two other sites, Topoxté and Mayapan. Osteologically, mass graves found in association with these temple assemblages are similar with regard to demography, levels of articulation, and mortuary treatment (the presence of cutmarks). However some differences in taphonomy exist, namely the variable presence of burning among the remains. The dating of the mass grave at Zacpetén is consistent with the time frame that the Kowoj took over the site and suggests that the grave at Zacpetén was produced as a part of that conquest in the form of sacrifice, burial of war dead, or exhumation of enemy ancestors. Thus in this case regional consideration of multiple lines of evidence was required to determine who was responsible for and who was subjected to mortuary violence.

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Mandibular bone stiffness in sooty mangabeys.

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Field research has established that mangabeys representing both *Lophocebus* and *Cercocebus* are adept at orally processing hard objects either seasonally or year-round. This feeding strategy is reasonably inferred to involve intense masticatory loads during ingestion. Much comparative investigation of skeletal responses to hard-object feeding has also focused on craniofacial morphometrics, such that the structural properties of mangabey mandibles are interpreted in the context of diet and feeding behavior.

By contrast, little is known of the material properties of mandibular bone as they relate to hard-object feeding in primates. In this study, we investigate bone stiffness in the postcanine corpus of four adult sooty mangabeys (*Cercocebus atys*). Hardness data were collected on coronal sections taken below M₁ via Vickers microindentation and converted to elastic modulus through empirically-derived regression. Our sample represents a population from the Taï Forest, Côte d'Ivoire, in which the most frequently consumed foods are the very hard (i.e., stress-limited) seed casings of *Sacoglottis gabonensis*.

Elastic modulus averages 18.5 GPa within the sample. Sooty mangabeys show significant variation in bone stiffness among individuals, with significant differences between alveolar and basal regions. Nevertheless, *Cercocebus atys* is shown to have significantly stiffer mandibular bone than that of sympatric colobine monkeys. While this finding invites speculation that the material response to durophagy involves stiffening of bone tissue, other data collected to date – albeit limited – suggest that cercopithecines as a group have stiffer bone than colobines, irrespective of the incidence of hard foods in the diet.

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Captive female orangutans do not exhibit hormonal signs of age-related reproductive decline.

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The female post-reproductive period has often been viewed as a unique life history phase of *Homo sapiens*, possibly selected for because of the beneficial role of grandmothering to inclusive fitness. Yet differences in how investigators define and operationalize “menopause” and “post-reproductive” life stages has recently led to disagreement as to the presence or degree of reproductive decline in other hominoid species, including gorillas and chimpanzees. To date, little demographic or endocrinological data have been available from which to draw conclusions about orangutan reproductive aging. The results presented here, derived from enzyme immunoassay analyses of over 350 urine samples from 3 captive female orangutans over the age of 35, suggest that female orangutans in captivity do not show hormonal signs of a post-reproductive life history stage: average levels of estrogen and progesterone during the peri-ovulatory period are not significantly lower among these females than among 3 captive females between the ages of 15 and 25, nor are the menstrual cycles of the older females significantly more irregular. For two of the older subjects, comparison with urine samples from 15 years ago further reveals that ovarian function, as determined by average reproductive hormone levels, does not decrease with time in individual females.

The discovery that ovulation and reproductive functions do not cease among aging female orangutans suggests that the physiological transitions that characterize menopause do not have a long evolutionary history among apes, lending support to the notion that the post-reproductive decades of the human lifespan are a unique life history phase.

First time analysis of Tell Abraq proximal femora using micro 3-D scanning: analytic implications for age estimation and beyond.

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Microstructurally, bone loss occurs with increasing age in the trabeculae. Using radiography, other researchers have studied the applicability of using trabecular architecture as an indicator of age at death. However, primary and secondary groups of the trabeculae are impossible to distinguish using radiography and fine trabeculae that are resorbed first are not visually apparent radiographically until at least 30% of the bone has been lost. A new methodology that can recognize these trabeculae was tested for its applicability to resolve this problem. Intact proximal femora (n=70) from the Tell Abraq collection in United Arab Emirates (dating to 2200-2000 B.C.) were analyzed using Micro-CT scanning at 93 μm isometric resolution using an eXplore Locus RS Small Animal MicroCT Scanner (GE Healthcare, London, Ontario) in order to obtain an accurate age of death and for understanding disease patterns for individuals buried in an undisturbed Bronze Age tomb. Image analysis was performed using visualization tool MicroView 2.1.2. Images obtained through this method were superior to traditional radiography, and revealed resorption of the finer trabeculae structures. One surprising conclusion was that individuals without signs of age-related osteoarthritis were actually much older based on the trabeculae. Age estimation revealed that there were 25 individuals (35.7%) aged between 30-40, and 19 (27.1%) aged between 40-50 year category. There were several individuals deemed to be over the age of 60. While most of the individuals were free of pathology, there were a few cases (approx. 8%) of osteoarthritis, osteoporosis and one case of extreme femoral head fracture.

Biogeochemical assessment of forest structure and dietary ecology at Rudabánya.

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In Europe, the Late Miocene marks the extinction of many forest adapted faunal forms, including many of the hominids, which diversified successfully during the Middle Miocene. In western and eastern Europe, the decline of hominids occurs in correlation with increasing seasonality and aridity, as well as a shift in vegetation from closed canopy subtropical evergreen to deciduous forest and woodland. In central Europe, floral and faunal data indicate the persistence of humid densely forested conditions throughout this period. The rich Late Miocene hominid locality of Rudabánya in northern-central Hungary provides a unique opportunity to investigate the impact of environmental change on central European hominids. Here we examine forest canopy structure and dietary ecology at the R. II locality at Rudabánya, using trace element (Sr, Ca, Ba), as well as carbon ($\delta^{13}\text{C}$) and oxygen ($\delta^{18}\text{O}$) stable isotope analyses of fossil tooth enamel. Utilizing

these biogeochemical indicators together allows for the discrimination of subtle differences in ecology. The sample includes 10 genera of medium to large bodied herbivores. $\delta^{13}\text{C}$ values indicate foraging in a range of forested environments, from densely closed canopy forest to more open woodland (-17.0‰ to -9.7‰). Significant differences in trace element (Sr/Ca, Ba/Ca) and stable isotope ratios, confirm the partitioning of resources amongst the sampled taxa. Suids, cervids, and equids show higher mean Sr/Ca and Ba/Ca ratios, as well as $\delta^{13}\text{C}$ values than bovids, moschids, and tragulids. These results provide insight into the paleoecology of central Europe during a highly dynamic period in hominid evolution.

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Flores feet, factoids and fairytales.

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Continuing restricted specimen access yielded a limitedly descriptive but richly imaginative study of the LB1 foot (2009) including two statements about limb segment proportions: "the foot of LB1 is very long relative to the femur and tibia" and "the relatively high foot-to-femur ratio...is driven primarily by an exceptionally short hindlimb." Seemingly transitive, these statements have contrasting functional and developmental implications demonstrable by escaping within-limb constraints through comparisons beyond foot to femur or hind limb alone.

Estimated fleshy foot length of LB1 is 196 mm (95% prediction interval 189-204 mm). Reportedly "[T]he relative foot length in LB1 far exceeds the upper limits for modern humans of either average or short stature." However, LB1 absolute foot length is only marginally below the minimum (207.5 mm) in a sample of 1905 USAF women (Clauser et al. 1972) permitting extensive bivariate comparisons. Stature predicted by regression equation from foot length is not 1.06 m but 1.46 m, supported by numerous limb segment comparisons, based on anthropometrics (Clauser et al. 1972) or osteometrics (Sjøvold 1990) using bone lengths of LB1. Including the LB1 femur biases stature estimates downward by 7 to >20 cm; Eckhardt et al. (2005) previously showed that Asian population regressions including LB1 femur length reduced estimated stature by >5 cm. The LB1 foot, while abnormal in various salient ways reflecting compromised locomotion, is not unusually long; rather, the femur of LB1 is abnormally short. Positing LB1 skeletal features as ancient primitive retentions requires not stasis of evolutionary change but suspension of disbelief.

Significance of the UI-Stanford Collection.

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The UI-Stanford Collection, currently housed in the UI Office State Archaeologist, is the third largest collection of human remains in North America and holds more than 1,100 individuals. Specimens were collected in Stanford, California between 1920-1950 to be studied by the medical university. Documentation records include information on date and place of birth, date and place of death, medical history, primary cause of death, contributory cause of death, occupation, and length of residence at place of death. This collection remains largely unknown and understudied by researchers. One of the few recent studies was a macroscopic investigation of pathology in the collection. There are 243 individuals with pathology. Pathology in the collection includes osteoarthritis, osteoporosis, periostitis, and fractures. Further investigation of fractures found 113 total fractures within 75 individuals. A majority of these fractures occur in the fibula. The UI-Stanford Collection comes from a pre-antibiotic and pre-modern health care era, which makes it useful as an evolutionary comparison with prehistoric and historic humans. The collection includes individuals from Japan, China, Korea, the Philippines, and Mexico, but does not include any Native Americans. The UI-Stanford Collection possesses unique characteristics that are useful for study. This includes but is not limited to a large number of pathological specimens, a diversity of individuals with varying biological affinities, and immunity from major ethical dilemmas facing other collections resulting from acts like NAGPRA, and it would be beneficial for future researchers to take advantage of this underutilized collection.

Maximum heritability as an indicator of relative developmental stability among populations.

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Narrow sense heritability (h^2) is the portion of phenotypic variation that is due to additive genetic variation, which is inversely related to environmental effects. Estimates of h^2 are not generalizable, so assessing it in one population is not informative about any other population. Presumably, however, in populations with low resource competition, healthy nutrition, low disease rates, minimal pollution, and a high standard of living, individuals have fewer impediments to development, and therefore higher h^2 . If h^2 estimates in such populations converge on a proportion, that proportion could potentially be an upper threshold, or "maximum heritability." Estimated h^2 in various populations could then be compared with this "maximum" as

a relative indicator of developmental stability and potentially, secular change.

Carabelli's trait is a frequently studied dental morphological characteristic for which h^2 has been estimated in many different populations. Estimates of h^2 for Carabelli's trait range from 0.07 to 0.91. As a test of the concept of "maximum heritability," this paper presents new h^2 estimates for Carabelli's trait from two populations that experience very high standards of living: Australians (n=300 twin pairs) and Americans (n=100 sibling and parent/offspring pairs) of European descent who were children during the last part of the 20th century. Across both dentitions among the Australians h^2 is estimated as 0.74-0.81; work with the American sample is ongoing. Estimates for these two groups are compared with the literature to determine the extent to which h^2 reflects what can be known about developmental health in various populations.

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Quantitative measures of iris color using high resolution photographs.

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Our understanding of the genetic architecture of iris color is still limited. This is partly related to difficulties associated with obtaining quantitative measurements of eye color. Here we introduce a new automated method for measuring iris color using high resolution photographs. This method extracts color measurements in the CIE 1976 L*a*b* (CIELAB) color space from a 256 by 256 pixel square sampled from the 9:00 meridian of the iris. Color is defined across three dimensions: L* (the lightness coordinate), a* (the red-green coordinate), and b* (the blue-yellow coordinate). We applied this method to a sample of individuals of diverse ancestry (East Asian, European and South Asian) that was genotyped for the *HERC2* rs12913832 polymorphism, which is strongly associated with blue eye color. We identified substantial variation in the CIELAB color space, not only in the European sample, but also in the East Asian and South Asian samples. As expected, rs12913832 was significantly associated with quantitative iris color measurements in subjects of European ancestry. However, this SNP was also strongly associated with iris color in the South Asian sample, although there were no participants with blue irides in this sample. The usefulness of this method is not restricted only to the study of iris pigmentation. High-resolution pictures of the iris will also make it possible to study the genetic variation involved in iris textural patterns, which show substantial heritability in human populations.

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Trust (OIT). Melissa Edwards and Agnes Gozdzik were supported by scholarships from NSERC (NSERC CGS M to Melissa Edwards and NSERC PGS D to Agnes Gozdzik, respectively).

Limb bone diaphyseal structure and its mechanical significances in lorises.

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Lorises are characterized by its slow arboreal quadrupedal walk, and some adaptational inferences have been made on their limb morphology in relation to this unique locomotion. This study compared cross-sectional properties of humeral and femoral mid-shafts of lorises with those of other primates, and reexamined previously suggested morphological characteristics of lorises and its mechanical significances. The diaphyseal structure of long bones is suggested to be related to the stresses produced by locomotion and body weight support. Cross-sectional properties such as cortical areas, second moments of area, and section moduli were collected from the micro CT images (voxel size 0.02 - 0.05 mm). The sample included five lorisid species (*Loris tardigradus*, *Arctocebus calabarensis*, *Nycticebus pygmaeus*, *N. coucang*, and *Perodicticus potto*) and other small primates (galagids, lemurids, platyrrhines, and cercopithecids). We found that lorises can be divided into two morphotypes. The differences between two similarly-sized species, *Nycticebus pygmaeus* and *Arctocebus calabarensis*, indicated that the variation is not allometric. *Perodicticus* and *Nycticebus* show high cross-sectional property values, having a very high safety factor for their body mass and previously reported ground reaction forces. *Loris* and *Arctocebus* have longer bone lengths and smaller total subperiosteal areas relative to body mass than other primates, implying that their limb bones are weak against bending. However, because of the thick cortices, their cortical areas relative to body mass are equivalent to the other primates of similar body size; thus, their long bones have enough strength against axial loadings.

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Do female brown capuchin monkeys use affiliative behavior to mediate stress?

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Physiological mechanisms are best understood in their ecological and evolutionary contexts. The inexorable dynamic between an organism's behavior and its underlying mechanisms, however, is most frequently studied in a captive setting meant to control for natural variation. For a few taxa (namely rodents and primates), laboratory studies have assessed the importance of social relationships in the management of stress but there is a noticeable lack of corroborative field data from wild populations. Using brown capuchins (*Cebus apella*) as our study system, we studied fine-scaled social behavior of individual females (n=7) and tested hypotheses regarding the stress hormone cortisol and female social relationships. As the relationships of female *C. apella* in Raleighvallen, Suriname are best described as transient and situation-dependent, do the shifts in female social behavior co-vary with physiological stress?

Overall, female glucocorticoid concentrations were not associated with rates of affiliative behavior or with monthly shifts in social relationships. Emergent patterns, however, provide indication of the social mediation of female stress: (1) females received more grooming from strongly bonded troopmates during periods of elevated stress, and (2) an inverse association between female cortisol levels and their grooming of adult males (after controlling for rank) further supports our previous finding that, despite being classified as a female-bonded species, females in this population are more closely bonded to males than to females. These intriguing patterns implicate the potential stress-reducing effects of a strengthened social relationship and provide a framework for future studies regarding the hormonal mechanisms driving sociality.

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Grandfather's age at father's birth is associated with longer telomere lengths in grandchildren in the Philippines: a case of adaptive intergenerational signaling?

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Telomeres are repetitive DNA sequences found at the ends of chromosomes that shorten with age in proliferating human tissues. This shortening is implicated in senescence, with previous work suggesting that shorter telomere length (TL) impairs immune and cardiovascular function and results in increased mortality.

Contrary to the TL shortening which occurs with age in most proliferating tissues,

several studies report that TL in sperm of older men tend to be longer than in younger men and, correspondingly, that offspring of older men inherit longer TL. We recently hypothesized that this paternal age effect on offspring TL is a mechanism for transmitting information about environmental experiences in recent generations to adaptively adjust offspring physiology. For the paternal age effect on TL to convey reliable information, it was predicted that the paternal age effect would exhibit a multi-generational character, providing integrated and thus more reliable information. This model leads to the prediction that grandfather's age at the conception of the parent will be associated with longer TL in the grandchild.

Blood TLs (BTL) from young adults from Cebu, Philippines were measured. Consistent with previous findings, having an older father was associated with longer BTL (n=1,639, p<0.001). Consistent with our prediction, older paternal grandfathers had grandchildren with longer BTL (n=223, p=0.04). No such effect was found for maternal grandfathers (n=333, p=0.331). The effect sizes of the associations are large enough to be of biological importance.

These findings provide the first evidence that grandfather's age at father's conception influences grandchildren's TL.

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Of fugitives and refuges: coexistence despite intense interspecific competition in hylobatids.

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Competition between ecologically-similar species can be particularly intense; however, coexistence may be possible through interspecific dominance relationships. Because dominant groups cannot occupy all food patches at one time, resources may be divided spatio-temporally. It has been hypothesized that subordinate species may 1) function as "fugitives" by avoiding encounters and more rapidly utilizing renewed patches, or 2) rely on competition refuges (i.e., lower-quality, less-defended resources). Either strategy may promote coexistence, but will increase travel costs and decrease energy intake for the subordinate species. I investigated these mechanisms in sympatric siamangs (*Symphalangus syndactylus*, 4 groups) and agile gibbons (*Hylobates agilis*, 2 groups). Siamangs dominated agile gibbons in encounters that were frequent, aggressive, and energetically costly. Data were collected from September 2008 to October 2009 on ranging and feeding patch use (N=1,900 feeding bouts, 1,492 patches) at Way Canguk, Sumatra. The location, size and yield (i.e., % of crown covered by food items) of all patches, as well as patch residencies and feeding bout durations were recorded. Contra to the predictions for fugitives, agile gibbons neither started to feed earlier in the morning (Chi-square: P>0.05) nor traveled further between feeding patches (ANOVA: P>0.05) than

siamangs. In support of the competition refuge hypothesis, agile gibbons used patches with significantly less available food and had shorter patch residencies and feeding bout durations than siamangs. Patches used by agile gibbons, however, were significantly larger than those used by siamangs (ANOVAs: $P < 0.05$). In conclusion, agile gibbons are not fugitives, but rely, instead, on competition refuges for survival.

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The effects of physical activity and health status on bone strength development.

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Cortical bone adapts to environmental influences by altering its mass and shape at both macroscopic and microscopic scales. These alterations, in turn, influence bone strength. Biological anthropologists often examine cortical bone to infer *either* biomechanical loading (caused by physical activity) *or* metabolic status (an indicator of health) from human skeletal remains. However, this methodological approach is problematic, because these factors do not act independently but rather interact in shaping bone morphology and strength. Although the existence of such an interaction is acknowledged in theory, it has yet to be thoroughly assessed in humans. An understanding of this interaction is critical for the proper interpretation of behavior from the archaeological record.

A juvenile (0-18 years) archaeological sample ($n=140$) from a Roman Egyptian cemetery (Kellis 2) was utilized, as bone is most responsive to environmental influences during growth. Macroscopic and microscopic bone morphology was assessed in three skeletal elements under different levels of biomechanical loading (i.e., femora, humeri, ribs) and compared among individuals with varying amounts of metabolic stress (inferred from skeletal stress markers). It was hypothesized that as biomechanical loading demands increase among the three elements, systemic reductions in bone mass due to metabolic stress are increasingly attenuated to maintain proper bone strength.

Results generally support this hypothesis. Ribs exhibit significant reductions in macroscopic bone mass with metabolic stress, while femora demonstrate minimal reductions, and humeri are intermediate. Likewise, ribs possess the most significant microscopic loss relative to long bones, as expected; however, femora and humeri have similar microscopic bone mass.

Estimating body mass in the *Theropithecus oswaldi* lineage using long bone ends.

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Theropithecus oswaldi was a terrestrial omnivorous cercopithecine monkey known

from the Pliocene and Pleistocene of Africa. Using craniodental measures, many authors have noted a trend of increasing size through time. A lack of relatively complete elements has hampered evaluation of this trend using postcrania. This study aims to estimate body mass in *T. oswaldi* over approximately 3.5 Myr using proximal and distal fragments of the long bones, which are relatively abundant at fossil sites. Of the 15 predictor variables assessed by Eller et al. (2011) on a large sample of extant cercopithecoid long bone ends, the five best performing (R^2 above 0.90, within 80% of actual value more than 75% of the time, and mean prediction error below 15%) were used to estimate mass: proximal humeral anteroposterior diameter, humeral biepicondylar breadth, femoral head anteroposterior diameter, femoral bicondylar breadth, and tibial bicondylar breadth. These were analyzed on 172 humeri, radii, femora, and tibiae attributed to *T. oswaldi*. Fossil data is from seven sites in Ethiopia, Kenya, and Tanzania and samples 23 time horizons between 3.5 to less than 0.5 Ma. Results indicate a clear increase in size through time, with early samples close in size to extant baboons (e.g., Hadar, Denen Dora, female range 8 – 17 Kg; male range 19 – 28 Kg) and the younger populations (e.g., Ologesailie, female range 33 – 58 Kg; male range 67 – 102 Kg) represent the largest cercopithecoids known. Our results overlap the values found by Delson et al. (2000) based on other postcranial, cranial, and dental data.

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The trouble with tarsiers: heterogeneity in the relationship between neocortex volume and social group size in primates.

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Comparative and classical statistical methods agree that social group size is a good predictor of neocortex volume in primates. Here I examine this finding using novel statistical methods that directly model heterogeneous multivariate coevolutionary processes allowing the correlation structure of evolving traits to vary across clades and across branches grouped by discrete characteristics such as diet or activity cycle. I find that the correlation between social group size and neocortex size may be stronger than previously reported, but only in certain types of primate.

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Going head to head: FORDISC vs. CRANID in the determination of ancestry from craniometric data.

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The computer programs FORDISC and CRANID are frequently used to determine the ancestry of human skeletal remains. Using forms of Discriminant Function Analysis, they compare cranial measurements of an unknown specimen to specimens in reference databases to identify the likely ancestry of the unknown. Both rely heavily on W.W. Howells' database of archaeological specimens for their reference samples. When analyzing an unknown using Howells' data, FORDISC allows up to 82 variables to be entered in any combination and can constrain its searches by sex and/or geographic region. In contrast, CRANID requires 29 specific variables and its searches cannot be limited by sex or region.

Several studies have tested FORDISC and challenged its accuracy, but CRANID has not been similarly tested. Nor have the two programs been systematically compared. With this in mind, the present study used 200 specimens from the Howells reference sample to compare how each program performs using the same 29 variables.

The results indicate that FORDISC and CRANID achieve similar success rates for ancestry determination using the same 29 variables. However, the number of correctly identified specimens was lower than previous tests of FORDISC had achieved using 56 variables. In addition, although FORDISC and CRANID use similar methods, ancestry determinations were not always consistent between the two. More problematically, neither of the programs' recommended acceptance criteria separated correct and incorrect results unambiguously. Overall, both programs performed below expectations and should be used with caution when assigning ancestry to skeletal remains.

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Glottal pop vocalizations in mantled howler monkeys (*Alouatta palliata*) facilitate and predict the direction of group travel.

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Group living species often rely on vocal communication to maintain spatial and social cohesion among group mates. These vocalizations become increasingly important during travel when individuals experience the greatest risk of becoming separated from the group. Several authors have suggested that male howler monkeys produce glottal vocalizations to help facilitate and coordinate group travel. However, quantitative assessments of the use and function of these calls are limited. To better understand the role of glottal vocalizations in traveling contexts, we analyzed over 250 hours of spatial and behavioral data collected on a single group of mantled howler monkeys (3 adult males, 6 adult females) in June and July of 2010 on Barro Colorado Island, Panama. We found that glottal vocalizations occurred in 74 percent of observed group movements, with the greatest proportion of calls occurring at the end of a long rest period and/or near the start of a travel

progression ($\chi^2 = 50.5$, $df = 3$, $p < 0.01$). All three males produced glottal vocalizations with equal frequency, and in all successful initiations of group travel, the azimuth of the groups' final trajectory was significantly clustered around the caller (Rayleigh Test of Uniformity for Circular Variance, $R = 0.2146$, $N = 33$, $p < 0.05$). These data support the hypothesis that glottal pop vocalizations by male howlers function as an auditory signal to both motivate and direct group travel.

Estimating load distribution across the radius and ulna in humans and non-human primates.

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The morphology of the wrist joint in extant hominoids is fundamentally different from other living anthropoid primates. One distinguishing feature is the retraction of the ulna from direct contact with the carpals. This feature is often linked to increased forearm pronation/supination motion and may allow for increased suspension/climbing behaviors in this group. Morphological changes associated with an increase in wrist joint mobility may also bring with it a unique pattern of load distribution between carpals and forearm bones (i.e., radius and ulna) during weight support. The goal of this study was estimate how loads may be distributed into and between the radius and ulna in primates that have different wrist joints morphologies (i.e., with and without ulnar-carpal contact; monkeys vs. hominoids, respectively). Cortical area (CA), our proxy for compressive strength and derived from CT scans, was calculated from cross-sections in several locations throughout the length of the radius and ulna in sample of humans and non-human primates ($n=75$). As predicted, CA in the ulna (relative to CA in the radius at the same level) increases from distal to proximal in all taxa; this transition increases at a significantly higher rate in monkeys. Contrary to expectations, however, relative CA in the distal end of the ulna is not different between hominoids and monkeys. Our results suggests that the more mobile wrist joint evolved by hominoids as a consequence of fully retracting the ulna from the carpals may not have significant effects on how compressive forces are transmitted into their forearms.

Variation in muscle mass in wild chimpanzees: application of a modified urinary creatinine method.

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Creatinine, which is frequently used to standardized urinary hormone levels, is a breakdown product of creatine phosphate, an amino acid concentrated in muscle tissue.

Because of its derivation in muscle, the amount of creatinine that an individual excretes in 24 hours is a reliable and frequently-used indicator of relative muscle mass in humans and other lab animals. While it is not feasible to collect 24-hour urine samples from wild primates, we apply here an easily accessible method to approximate muscle mass variation from collections of spot urine samples. Specific gravity (SG), an alternative method for assessing urinary water content, is both highly correlated to creatinine and free of mass-dependent effects. Individuals with greater lean body mass should excrete more creatinine for a given urine concentration. We examine this relationship a dataset of ~10,000 urine samples from wild chimpanzees in the Kibale National Park, Uganda. As expected from known differences in body composition, the slope of the relationship between SG and creatinine is significantly greater in adult males than adult females. Furthermore, changes in the creatinine-SG relationship closely approximate previously-described weight curves in chimpanzees, stabilizing at approximately 10 years of age in females but peaking several years later in males. Beyond these validating relationships, we demonstrate the applicability of this method for empirical examinations of muscle mass variation, including significant positive correlations with testosterone in males, reductions with reproductive effort in females, and age and status related effects.

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Swing phase energy storage in the goat fascia lata has implications for the function of the human iliotibial band.

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The human iliotibial band (ITB) is a complex structure in the lower limb derived from the fascia lata (FL) of the thigh that is unique to humans among apes but whose function is not well understood. The anatomy of the ITB makes it a candidate for elastic energy storage and recovery of the limb's fluctuating energy in swing. Because *in vivo* measures of human muscle and tendon function are limited and the FL of cursorial quadrupeds may be convergent with the human ITB, we used a goat model to examine energy storage. Sonomicrometry crystals were implanted in the FL to measure strain during locomotion. Using sonomicrometry and electromyography, we also examined how the tensor fascia lata and gluteobiceps (GB) muscles contract to transmit force via the FL.

If the goat FL stores energy at the end of stance and recovers the energy in initial swing, we would expect the FL to stretch through stance and then shorten after initial swing. During trotting and galloping, the FL stretches through the stance-swing transition and then shortens after initial swing. While the FL stretches GB actively shortens, indicating that the FL is

stretched by GB contraction. These data indicate that the goat FL stores and recovers elastic energy during swing. These results suggest that swing phase energy storage in the human ITB should be explored further. The role of the human ITB in energy storage is likely to improve the economy of human gait and may provide insight into the evolution of bipedalism.

Ancient mortuary rituals in a high altitude population in Nepal: cut marks among shaft tomb burials from Upper Mustang.

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Ancient high altitude populations who occupied the Upper Mustang region of Nepal made extensive use of shaft tombs for mortuary practices. Exploration of the Sam Dzong valley has uncovered human burials dating to the 5th-7th centuries AD. Four of the 10 tombs explored yielded human remains, for a minimum of 33 individuals, including 10 subadults and 23 adults (10 males, 11 females, and two of unknown sex). Postmortem cut marks were found on a minimum of 72.7% (24/33) of these burials, located on many elements of the axial and appendicular skeleton, including the skull, ribs, scapulae, os coxae, and long bones. Among the 24 burials with cut marks were nine adult males (37.5%), nine adult females (37.5%), one adult of unknown sex, and five subadults (20.8%). The distribution of cut marks across the age groups from juveniles to older adults, and among males and females suggests relatively equal mortuary treatment across age and sex. Among the faunal remains also found within the tombs were a minimum of 25 caprids, eight bovids, six horses, and one hare. Several had cut marks, including four caprids, one horse, and one bovid.

All cuts were made with a sharp implement, showed no signs of healing, and were located in areas that suggest defleshing. In the 11th-12th century AD, this area adopted the Tibetan practice of "sky burials," but the Sam Dzong burials pre-date this period. These findings offer new evidence for exploring complex mortuary behavior among high altitude populations in Nepal.

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Rhesus macaques (*Macaca mulatta*) use snake postures to identify intensity of threat.

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When predators are detected, prey must make decisions about how to respond. The decision on which strategy to adopt is based on a cost-benefit analysis of risk level. The Threat-sensitivity hypothesis predicts that prey should match their response to their predation risk, with high-risk predator encounters eliciting stronger evasive responses than low-risk encounters. Primates are known to vary in their responses

toward different types of snakes or snakes in different contexts. We asked if primates are sensitive specifically to different threat levels presented by snakes as revealed by the snake's posture. In a series of experiments, we presented snake models in different postures to captive rhesus macaques (*Macaca mulatta*) at the California National Primate Research Center. We found that rhesus macaques respond more strongly to snake models in striking pose relative to a coiled posture, and more to a coiled posture than to an extended traveling snake. Thus, macaques perceived intensities of threat that parallel our own perception of intensities of threat from snakes. Additionally, a partially covered snake evoked a response comparable to that of the striking snake, suggesting that when conditions limit opportunities for complete risk evaluation, primates respond as if they are under high risk.

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A three dimensional analysis of femoral cortical canal structure in Middle Holocene, Lake Baikal hunter-gatherer-fishers.

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This research tests the ability of microcomputed tomography (micro-CT) to detect three dimensional age-related changes in the cortical canal structure of archaeological femora. Samples, derived from middle Holocene Cis-Baikal hunter-gatherer-fishers (n=90), were scanned, and seven variables were analysed. Results for the pooled sample produced trends similar to those detected in a modern sample. Canal number and separation differed among adolescents and young adults when compared with middle and old adults (ANCOVA and ANOVA, $p < 0.05$). Males and females displayed differences in age-related trends for canal number, separation, diameter, and canal surface to canal volume. For males, canal number and separation remained significantly different between young and old adults (ANOVA, $p < 0.05$). In females, however, significant differences were found for canal diameter and canal surface to canal volume, when comparing adolescents to young and old adults (ANOVA, $p < 0.05$). Differences between the sexes were also found for canal number and canal separation (t-test, $p < 0.05$), with females maintaining larger canals with less distance between them.

Micro-CT proved successful in detecting age-related cortical canal changes in prehistoric femora. Significant differences were identified between age-at-death categories, which appeared to be associated with the transition into middle adulthood. Differences between the sexes, in trends and the variables identified as significant, were likely physiologically-based, although the possibility of an activity-based component exists. Ultimately, micro-CT provides a new and compelling avenue for detecting age- and sex-related changes in cortical microstructure,

allowing novel insight into bone quality in past populations.

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Incorporating gene flow in evolutionary models for the peopling of the Americas to estimate the size of the founder population.

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Recent evolutionary models for the peopling of the Americas have emphasizing the role of recent (Holocene) gene flow with Asian populations. A recent work used Approximate Bayesian Computation and a large dataset of ~400 STR markers typed in 30 Native American and Asian populations found that a scenario with recurrent gene flow between populations from the two continents during the Holocene received strong posterior support. A better characterization of the size of the original founder population for the peopling of the Americas may be important to access the level of genetic and morphologic variation harbored by these initial settlers. However, because the presence and strength of gene flow may affect estimates of the initial population size for the peopling of the Americas we aim at estimating the size of such founder population using 9 intergenic autosomal loci irrespective of the level of gene flow. DNA samples from ten Native American individuals, eight Siberians were used together with information from 15 Han Chinese individuals available from the literature. Genetic data for these individuals were used in an Isolation-with-Migration scenario with or without gene flow in the program IM. Our results suggest that the original Native American founder population had between ~75 and ~4,850 individuals, even though the most likely numbers are around 200 individuals. This implies in a moderate to strong bottleneck which is consistent with estimates from other genetic markers. This estimate may be useful to understand how variable in morphology the initial settlers might have been.

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Unassisted child birth in the US: results from an online survey.

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In response to the medicalization of birth in the United States, women are seeking alternative birthing options. The use of midwives for prenatal care, labor, and delivery is gaining recognition as an alternative to obstetrician care. A smaller segment of birthing mothers are

choosing to experience unassisted home birth (birth without the assistance of a birthing professional) and solo home birth (birth without assistance from any person).

Facebook (FB) is a major source of information and support for mothers and mothers to be. There are currently three FB pages that support unassisted birth with 10,410 FB users who have 'liked' these pages.

As a preliminary step into research with the unassisted birthing community, a survey was posted to these three FB pages. The surveys sought basic demographic data and childbirth scenarios that the respondents had experienced. The survey received 215 respondents. Birth experiences varied with the majority stating they had given birth with a midwife attending (83%). Most respondents (84%) had given birth at home. Respondents reported giving birth at home without the assistance of a professional birth attendant (34%). Approximately half of these 'unassisted births' were 'caught' by a friend or family member (18%) and 34 (16%) respondents stated they had given birth at home and 'caught' their own baby.

These data indicate that within a segment of the Euro-American population (99% of respondents) that is moving away from medicalized birth, the majority of births are attended by birth professionals. These data support the theory of obligate midwifery.

Of supper and salvors: excavations at Audubon house (site 8MO220) Key West, FL.

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The Audubon House in Key West, its contents and grounds, are being restored. As part of this effort, the University of Miami excavated 5 units over 2 seasons. Material recovered related to food ways included ceramics, glass, and faunal remains. The ceramic inventory was used to date the deposits we report on to between 1830-1870. We used the recovered materials to shed light on the daily diet of this early, well-to-do, historic household. Material culture items used in food preparation and service were ceramic plates from China and England, wine bottles and beer jugs, and 1 knife handle. Cooking was done outdoors at an open hearth with which most food remains were associated. Material was classed as food by processing marks and/or burn marks. The diet included cattle (*Bos taurus*; N=11), hogs (*Sus scrofa*; N=2), chicken (*Gallus gallus domesticus*; N=3), key deer (*Odocoileus virginianus clavium*; N=5), fish (species unknown; N=6), oysters (*Crassostrea virginica*; N=4), conch (*Lobatus gigas*; N=11), green turtle (*Chelonia mydas*; N=3). These items are consistent with a diet that included both domesticated and wild animals, terrestrial and marine resources, as well as imported items like wine. No plant material was recovered. Although the data suggest that there was a significant emphasis on meat and seafood, we cannot fully know the breadth of the diet at Audubon House due to poor preservation conditions.

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Past human manipulative behavior in the European Holocene as assessed through humeral asymmetry.

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We test whether Holocene changes in manipulative behavior indicated by the archaeological record resulted in a decrease of sexual dimorphism in humeral asymmetry and we analyze the pattern of humeral asymmetry for males and females. We used a European sample of 2170 humeri divided into nine archaeological periods from the Upper Paleolithic to the 20th century. Asymmetry was compared using cross-sectional parameters obtained from 35% of humeral length and assessed using directional asymmetry (DA; i.e., direction and magnitude). DA in humeral cortical area non-significantly declines in European male sample from UP (11%) to Modern period (5%). Female DA in cortical area strongly declines from the Mesolithic (8%) to Neolithic (0%) but is followed by an increase to Modern period (5%). DA in Imax/Imin ratio indicates no differences between males and females. For both groups the DA in Imax/Imin decreases from the Mesolithic (0%) to the Modern period (-5%) with minimum in Roman period (-8%). DA in robusticity (Zp) decreases from UP (23%) to the Mesolithic (4%) but remains stable during later periods of Holocene in male sample. In female sample the DA in humeral robusticity shows a slightly different pattern where females decline from UP (14%) to Bronze Age (3%) but increase to Modern period (8%). Differences between males and females in DA indicate that sexual dimorphism of cortical area and robusticity decreases throughout the Holocene but Imax/Imin remains unchanged. In conclusion, changes in manipulative behavior in Holocene have impact on both sexes in DA of cortical area and robusticity.

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Feeding ecology of wild geladas (*Theropithecus gelada*) over an annual cycle at Guassa, Ethiopia.

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Geladas (*Theropithecus gelada*), graminivorous monkeys endemic to the alpine grasslands of Ethiopia, and their extinct theropithecine relatives have long been used as models for understanding the diets of extinct hominins. To date, however, no published account of gelada feeding ecology over an annual cycle exists, and previous investigations of gelada ecology have been limited to populations occupying heavily degraded habitats. During a recent 15-month period, we found that a ~220-member gelada band inhabiting an unusually ecologically-intact grassland at Guassa, Ethiopia consumed a more diverse diet than extremely graminivorous populations studied at more disturbed sites elsewhere. At Guassa, geladas consumed >50 species of plants and >12 species of invertebrates and exhibited wide variability in their monthly diet, with monthly percentage consumption of grasses, herbs, and invertebrates ranging from 35%-74%, 19%-61%, 0%-8%, respectively. Overall, the geladas' annual diet consisted of 55% grasses (42.0% tall grass leaves; 8.8% short grass leaves; 2.4% other short grass parts; 2.2% tall grass seed heads), 37% herbs (28.8% herb leaves; 7.5% herb roots; 0.6% herb flowers), 3% invertebrates, and 5% other items (1.9% unidentified underground items; 1.6% underground storage organs; 1.3% pith). While geladas at Guassa can be classified as graminivores, their diet is considerably more varied than assumed by most modelers of extinct hominin evolution. Given that the ecosystem at Guassa is probably similar to the one in which geladas evolved, a diet dominated by a variety of grasses and herbs, with occasional bouts of invertebrate consumption, may be the 'natural' diet of geladas.

This study was funded by Pittsburgh Zoo, Margot Marsh Biodiversity Foundation, Primate Conservation Inc., and Cleveland Metroparks Zoo.

The human skeletal remains from Herculaneum: new evidence from the excavation of the *formici* 7, 8, 9, 10 and 11.

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The human odontoskeletal sample recovered from the excavation at Herculaneum represents a portion of a "living" population, who died trying to escape from the eruption of the Vesuvius volcano in AD 79. Between 1980 and 1997, 248 individuals were recovered from the beach and from the 9 *formici* (boat chambers) where they were sheltering from the impact. A further 107 individuals were recovered during the excavation in 2008-2010 from *formici* 7, 8, 9, 10 and 11. The Herculaneum skeletal sample has

been the subject of a number of scientific investigations. Nevertheless, for reasons related to the complex articulation of the archaeological record, it was not possible to fully consider the dynamics of the sample formation.

The sex and age distribution of the new sample changes substantially the previously proposed scenario where a sex ratio strongly unbalanced towards males and a deficiency of infant and juvenile individuals were interpreted as the effect of the earthquake that hit the region probably in AD 63. Results from the new sample show an opposite sex ratio (0.65) and the presence of a substantial amount of infants and juveniles among the death. This evidence, in the context of a reexamination of the whole sample, points toward the necessity for reconsidering whether the Herculaneum remains can be assumed as a randomly selected catastrophic sample. Conversely, the demographic profiles of the single *formici* sub-samples, together with historical and epigraphic considerations, point toward a sample formation process where social behavior and demography played an important role.

Dem dry bones: cyclododecane as a tool in osteological analysis.

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The stabilization of fragile archaeological materials is often necessary for their extraction, cleaning, and analyses. One method employed for stabilization is the application of cyclododecane, a volatile cyclic alkane. Cyclododecane has primarily been used in museum contexts on sensitive artifacts such as paper, ceramics, and stone. Little is reported on its effectiveness for the stabilization of bone, which is often extremely fragile.

This research concerns the application of cyclododecane to friable bone from a prehistoric (A.D.1250-1350) site in southeastern Georgia, United States. The hypothesis is that reported solvent solution ratios for cyclododecane, and methods of application, would be effective in bone conservation. The goal was stabilization and reduced fragmentation during matrix removal, rendering a sample suitable for bioarchaeological and forensic osteological analysis.

Hypothesis testing included mixing reported solution ratios of cyclododecane and mineral spirits, applying the solutions using pipettes, and observing their effectiveness during sample cleaning and extraction. A solution ratio of 11/20 cyclododecane to solvent proved to be the most effective, which is less than solution ratios recommended for other archaeological materials. Complete solution sublimation took approximately two weeks using fume hood ventilation. The resultant samples were effectively stabilized, and are undergoing osteological analyses.

Cyclododecane is fairly well-known in museum conservation. This research demonstrates its potential for stabilization of bone in bioarchaeological and forensic settings. It is shown that the mixing and application of a

solvent solution allows for analysis of bone that may otherwise be too friable to examine.

This study was supported by the University of Georgia Laboratory of Archaeology and the Georgia Museum of Natural History.

Inferring positional behavior on the basis of osteometric characters: a model for the fossil taxon *Epipliothecus vindobonensis*.

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This study examines whether osteometric traits of the shoulder and elbow can be used to infer the positional behavior of extant and fossil taxa. Seven extant taxa for which there are published data on positional behavior (*Hylobates concolor*, *Ateles geoffroyi*, *Brachyteles arachnoides*, *Lagothrix lagothricha*, *Pygathrix nemaeus*, *Cebus apella*, and *Alouatta seniculus*), and one fossil taxon, *Epipliothecus vindobonensis* were selected for analysis. The extant sample was selected as these species engage in a wide range of positional behaviors. Thirty-eight osteometric characters of the shoulder and elbow were measured on each species and compared using Principal Component Analysis (PCA). The PCA identified several anatomical traits that are associated with specific types of positional behavior. It was possible therefore, to compare the shoulder and elbow anatomy of *Epipliothecus vindobonensis* to the anatomy of these extant taxa in order to infer its positional behavior. The humerus of *Epipliothecus* has a variety of features that are found in *Cebus*, *Alouatta*, *Lagothrix* and *Ateles*, but none of the extant taxa has the whole suite of features found in the fossil species. The results indicate that *Epipliothecus* is most closely associated with *Lagothrix*, and that *Epipliothecus*, like *Lagothrix*, engaged in quadrupedalism and suspensory behaviors.

Sexual swellings of wild Sanje mangabeys (*Cercocebus sanjei*) in the Udzungwa Mountains of Tanzania.

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The appearance of conspicuous sexual swellings during the fertile phase of the reproductive cycle is common to many catarrhine primates with multi-male mating systems, serving to function as some indication of female fertility. Ovulation typically occurs during maximum swelling, although since this period is frequently longer than the peri-ovulatory period, ovulation may not be possible to detect from swelling size alone. Changes in other physical attributes of the sexual swelling, however, might also serve to pinpoint the time of ovulation.

Here I describe sexual swellings and appearance in Sanje mangabeys (*Cercocebus sanjei*) living in the Udzungwa Mountains of Tanzania, and consider whether factors other than size may serve to pinpoint ovulation. I

ranked the sexual swelling size of 23 adult females using a 9-point visual scale and concurrently collected fecal samples for analysis of ovarian hormones during a 21-month study. Results indicate that mean cycle length for parous females was 29.6 (\pm 3.1) days (n = 28), during 89% (26.3 \pm 6.5 days; n = 37) of which females exhibited some swelling. Mean maximum swelling duration was 6.8 (\pm 7.0) days (n = 41). However, within the maximum swelling period, its appearance changed, acquiring a darker and shinier tone for 4.4 (\pm 4.0) days (n = 25) just prior to detumescence. I will test whether this change is associated with ovulation from fecal estradiol and progesterone levels. If, as suspected, it coincides with ovulation this suggest that sexual swellings act as a reliable indicator of fertility in Sanje mangabeys.

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Sexual dimorphism: a comparison of migrant and non-migrant Mexican populations.

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Variation in sexual dimorphism is related to average body size differences and limb proportions within males and females in a particular population (Charisi et al. 2011). Theory suggests that expression of sexual dimorphism relies on male susceptibility to impairment in long bone length during episodes of stress, while females are "buffered" from the same conditions due to reproductive demands (Frayer and Wolpoff 1985). This study evaluates the degree of sexual dimorphism between three populations in an attempt to examine different stress factors affecting individuals within and between migrant and non-migrant populations. The sexual dimorphism index (SDI) was calculated for long bone lengths in American White individuals from the Forensic Anthropology Data Bank (n =93), a migrant group of U.S. - Mexico border crossing fatalities from Tucson, Arizona (n =152), and a non-migrant Mexican group from Zimapan, Hidalgo (n =43). The SDI results demonstrate similar dimorphic levels between the modern American White and non-migrant Hispanic sample, while the migrant population shows lower dimorphic levels. Multivariate analysis also indicates significant degrees of sexual dimorphism between the three samples. Migrants that enter the United States via the Arizona border are thought to come from low-income areas (Duran and Douglas 1992). Potential explanations for the differing degrees of sexual dimorphism can be attributed to the interaction of socioeconomic status, division of labor, work load, and the environment. Furthermore, the different levels of sexual dimorphism observed between American Whites and the migrant group demonstrates the need for population specific methods of sex estimation.

A study of character: developmental approaches to modularity, integration and evolvability of the craniofacial skeleton.

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Modularity and integration are key mechanisms bridging development and evolution and are fundamental to understanding evolvability. Using the mouse model system, we investigate modularity and integration of the craniofacial skeleton with the aim of understanding its morphological evolution. We are particularly interested in mechanisms regulating jaw length and robusticity, especially as they relate to robust vs. gracile hominin phenotypes. Here we use our investigations of *Satb2*- and *Fgf8*-regulated craniofacial development as examples of how modules may be established and integrated during craniofacial development to propose a model for modular evolution. We use a comparative evolutionary developmental approach to show that *Satb2* regulates a distal module of the jaw through its coordinated expression in the symmetric, complementary domains of the mesenchyme of the developing upper and lower jaws. We show that the mandibular *Satb2*+ domain varies in relation to epithelial *Fgf8* expression, suggesting that modulation of *Fgf8* could provide a mechanism for evolutionary change in this domain. Additionally, we have found that *Fgf8* dosage affects mandibular length and robusticity. Based on these and other data from similar studies in Vertebrates, we identify patterns of character co-variation that might lead to robust hominin phenotypes and test these hypotheses using data collected from murine and primate crania. Our results suggest that *Fgf8* acts as an integrator of mandibular morphology, interacting with other signaling factors to establish nested, hierarchical modules of the developing jaw. Evolutionary alterations in *Fgf8* signaling may therefore have contributed to morphological diversification in the hominin craniofacial skeleton.

Differences in activity patterns between mouse lemurs (*Microcebus griseorufus*) in protected and human-disturbed forests in the Beza Mahafaly Special Reserve, Madagascar.

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Although the physiological adaptations used by mouse lemurs (*Microcebus* spp.) in

response to Madagascar's unpredictable climates are well documented, information on their behavioral adaptations in coping with forest loss and disturbance is minimal. We investigated the impact of anthropogenic disturbance on the timing of mouse lemur (*Microcebus griseorufus*) activities in two adjacent deciduous forests in the Beza Mahafaly Special Reserve (BMSR) during a 1.5 month period. Parcel 1 of the BMSR is an intact, undisturbed forest while the neighboring forest patch remains unprotected. This patch is utilized by the local Mahafaly people for livestock grazing, resulting in a reduction of forest resources. Mouse lemur behaviors and time of activity were recorded during continuous focal sampling in both forests. Plant and insect abundance were monitored in both forests to explore variation in resource availability between the two forests.

Mouse lemurs displayed different patterns of activity in the two forests. They were encountered more frequently in the disturbed habitat than in parcel 1 with the majority of additional encounters occurring in the second part of the night (midnight to sunrise). Mouse lemurs in parcel 1 were more active in the early portion of the night (sunset to midnight) and they were encountered foraging more frequently during this time. In contrast, mouse lemurs in the disturbed habitat were encountered foraging more frequently in the second portion of the night. The results indicate that mouse lemurs alter their activity patterns in response to human disturbances, likely as a result of changes in resource availability.

This study was funded by a Colorado College Social Sciences Executive Committee grant and Colorado College Venture Grants.

Masticatory biomechanics and hard object feeding: cranial adaptations in *Cercocebus torquatus*.

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Mangabeys (*Cercocebus torquatus*) and Macaques (*Macaca fascicularis*) are two closely related taxa that present variations in craniofacial form and diet. In comparison with Macaques, Mangabeys are identified as hard object feeders, relying extensively on hard nuts. As such comparisons of how the skulls of these two species respond to mechanical loads may provide an insight into cranial adaptations to masticatory load production and resistance.

Multibody dynamic analysis (MDA) was conducted for the two species. These models are capable of predicting muscle activation patterns for a specified biting task. Two biting tasks were simulated at each tooth; 100N bites, and maximum possible bites, predicted by the model. These loadings were then applied to finite element models of the same specimens. In order to compare the way in which two skulls respond to the predicted loading regimens the results are analysed within the multivariate framework of geometric morphometrics (GMM).

The results of the MDA indicate that the Macaque is capable of producing biting forces

similar to *Cercocebus*. Yet given the same biting task the results of the finite element analysis (FEA) and GMM analyses indicate that the degree of overall skull deformation is slightly smaller in *Cercocebus* than Macaques. These species also differ in how they deform, globally (GMM) and locally (strains). In particular, differences in strain are predicted in the alveolar region. The extent to which such differences reflect dietary adaptations will be considered. This study also highlights the potential combined application of MDA, FEA and GMM to comparative functional analyses.

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Primate cranial diversity: comparisons among the major primate radiations contradict larger and more general trends.

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Previous studies of primate cranial anatomy have noted a number of trends in primate cranial evolution. For example, it has long been suggested that primate facial characteristics, particularly skull, snout, and palate length, scale with positive allometry throughout Order Primates. However, less attention has been paid to whether these general trends differ among the major primate radiations (lemuroids, lorisooids, platyrrhines, cercopithecoids, and hominoids) within the order. The factors driving cranial diversity within a given radiation may differ from those driving cranial diversity within another, and these differences may be masked by the appearance of overall primate trends.

In this study, we examine cranial diversity within the major primate radiations, first individually and then compared with each other as well as with the general trends seen across the order. We use 3-D geometrics on 18 cranial landmarks to capture cranial shape in 66 genera of living primates. Contrary to popular belief, facial dimensions such as skull, snout and palate length do not scale with positive allometry across all primates; lemuroids and lorisooids show no significant allometric relationship between these measures and size. Instead, cranial base flexion, relative orbit size, and relative cranial volume are the most obvious features correlated with size among strepsirhines. Thus, the apparent relationship between facial dimensions and body size in primates is the result of the strong correlation between these features in anthropoid primates. One may speculate that this relationship is the result of the cranial reorganization that took place during anthropoid origins.

This study was supported by the L.S.B. Leakey Foundation.

An example of ischiopubic hypoplasia in medieval Nubia.

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The objective of this presentation is to differentially diagnose an anomalous, bilateral non-fusion of the ischiopubic rami of a young adult female skeleton. This individual is one of 408 medieval period skeletons excavated from Mis Island, Sudan by The Sudan Archaeological Research Society and the British Museum. This Nubian skeletal collection is on loan to Michigan State University for research and documentation.

Fusion of the ischiopubic synchondrosis is typically complete between five and eight years of age. However, this individual is undoubtedly a young adult: long bone epiphyses are fully fused, mandibular third molars are erupted, and the first and second sacral bodies have fused.

The opposing surfaces of the unfused rami are rough, porous, and flared at the articular surfaces. This ossific pattern more closely resembles a pseudoarthrosis than the ridges and furrows of a typical epiphyseal surface. In addition, the bones of this individual are diminutive which may suggest a systemic pathological disease. Given the available skeletal evidence, we propose that this bilateral anomaly of the pelvis is the result of congenitally delayed ossification, known as ischiopubic hypoplasia.

Based upon a review of modern clinical literature, ischiopubic hypoplasia is the incomplete fusion between the ischium and the pubis. It is considered a non-specific finding since it is typically associated with other syndromes or disorders (Eich *et al.* 1992; Sferopoulos and Tsitouridis 2003). Due to its rarity, this is a significant discovery and a unique contribution to the bioarchaeology of the region.

Killed in action? A biomechanical cross-sectional analysis of femora of supposed battle victims from the Middle Bronze Age site of Weltzin, Germany.

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Since the 1980s, large numbers of predominantly commingled human bones and archaeological artifacts from the Middle Bronze Age were found along a stretch of about two kilometers in the river bed and on the bank slopes of the river Tollense, Germany. A preliminary analysis of the bones and artifacts suggests that a large battle was fought here and that the skeletal remains represent victims of that battle.

CT-scans of 29 femora from the site Weltzin 20, the first intensively investigated site of the area, were used to analyze mid-diaphyseal cross-sectional geometry, using ImageJ and MomentMacroJ v1.2. Areas were standardized by body mass, and moments of area by the

product of body mass and bone length. Obtained data were compared to Neolithic samples from the Bell Beaker and the Corded Ware cultures and to Bronze Age samples from the Únětice, the Unterwölbung, and the Wieselburger cultures using data from Sládek et al. (AJPA 130, 2006, 320-332).

Values for the Weltzin femora are closer to those of male than female femora from the assemblages used for comparison, corroborating previous determination of the Weltzin bones as predominantly male, based on morphological criteria. This is in line with the view that all or most femora represent battle victims. Moments of area are similar to those in the comparative male samples indicating similar activity patterns of the members of the different groups. This suggests that the combatants at Weltzin were probably common people rather than representatives of a specialized group such as professional warriors.

Is age at menarche related to final stature within individuals considered longitudinally?

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This report examines the extent to which developmental timing, as marked by longitudinal estimates of height growth and menarche, influences final stature. A conundrum exists in human biology. Epidemiological studies routinely report positive associations between age at menarche and adult stature. Longitudinal studies, however, do not find significant differences in adult height of early and late maturing females as judged using estimates of age at peak growth velocity (APHV). One study using data from the Fels Longitudinal Growth Study reports a small but statistically significant difference in adult height related to age at menarche. The present study uses longitudinal data from two districts in Taipei, Taiwan, as well as from the Berkeley Guidance Study to examine whether similar relationships between longitudinally estimated measures of developmental timing, menarche, and final stature may be identified in groups with diverse developmental backgrounds. No significant relationship between adolescent developmental timing, either APHV or age at menarche, and final height was demonstrated in either data set ($P > 0.10$). Differences in mean adult height among girls in the two districts in Taipei could be accounted for by differences at primary school entry. Claims that rapid changes in developmental environment experienced as preadolescents may predispose individuals to reduced final heights because of earlier menarche receive no support.

Investigation into human sacral fusion with regard to skeletal age.

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This presentation evaluates age-at-fusion of sacral segments in late 19th and early 20th century Americans. Langley-Shirley and Jantz (2010) demonstrated shifts in the timing of epiphyseal union of the medial clavicle in modern Americans as a result of secular changes in skeletal maturation. These changes should manifest in other maturation indicators. This project is the first portion of a two-part study investigating secular change in the fusion timing of sacral segments.

The sample consists of 177 European American and African American individuals aged 4-35 years from the Hamann-Todd Collection. Sacral segments were scored as (1) *unfused* (no bony bridging), (2) *fusing* (bony bridging between sacral bodies) or (3) *fused* (obliteration of epiphyseal line). Transition analysis using a cumulative probit model was conducted with Nphases2 (Konigsberg 2003). This method calculates a maximum likelihood estimate of the age-at-transition from one phase to the next (Boldson et al. 2002).

Results indicate that fusion between the first and second sacral segments (S1-S2) occurs significantly later than between S2-S3, S3-S4, and S4-S5. The transition from *unfused* to *fusing* in S1-S2 occurs at age 15 in females and 17 in males; the transition from *fusing* to *fused* occurs at 21 in females and 22 in males. The transition from *unfused* to *fusing* in the remaining sacral segments occurs around puberty in both sexes (9-12 years); the transition from *fusing* to *fused* occurs 3-5 years later. This presentation will compare these results to previous studies and discuss the utility of sacral segments as an age indicator in young individuals.

Capuchin postcranial adaptations.

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New studies have demonstrated a wide separation between tufted and untufted capuchins (genus *Cebus*; Erxleben 1777) and previously unacknowledged variability within the tufted capuchins. Within this framework, we reexamine the morphological variation in the postcranium across all capuchins, exploring the effect of body size and latitude as well as behavior and taxonomy. Data on over 50 capuchin skeletons are analyzed using both multivariate and bivariate analyses, and analyzing features of both the forelimb and hindlimb, as well as data derived from museum tags on ear length, foot length, and tail length. Patterns of variation within the tufted capuchins do not fully mirror the patterns of variation across all capuchins or within the untufted species group, suggesting some differences in the adaptive stresses on tufted vs. untufted capuchins. For example, limb length varies closely with body size across tufted capuchins, but within untufted capuchins limb length varies independently of overall body size. Limited data on tail length suggest much greater variation between tufted capuchins than across untufted capuchins, indicating either biomechanical or thermoregulatory constraints. The relative significance of different foraging

patterns, differing body size, and variations in quadrupedal behavior for morphological differences are discussed.

Enamel thickness and dental tissue proportions in Neanderthal and modern human upper deciduous molars.

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Enamel thickness and dental tissue proportions have been suggested as quantitative measurements useful to distinguish between Neanderthal and modern human permanent teeth. It seems obvious to apply the same to deciduous dentition. However, the intra-specific range of variability for these parameters in milk teeth is mostly unknown.

In this contribution we explore the variability of the 2D enamel thickness and dental tissue proportions in Neanderthal and modern human upper first and second deciduous molars.

The Neanderthal ($dm^1=8$; $dm^2=8$) and modern human ($dm^1=24$; $dm^2=25$) samples were scanned by means of μ CT (isotropic voxel size: 15-45 μ m). Firstly, the best-fit plane of the cervical line was determined. Secondly, the μ CT image stack was realigned so that this best-fit plane was parallel to the xy-plane of the Cartesian coordinate system. Finally, the enamel and dentine areas and the EDJ length were collected on each section perpendicular to the cervical plane of the tooth and passing through two of the dentine horn tips (i.e., dm^1 's paracone and protocone, and dm^2 's paracone and metacone dentine horn tips).

Our results show that Neanderthal dm^1 and dm^2 relative enamel thickness indexes (dm^1 's RET= 7.17 ± 0.54 ; dm^2 's RET= 10.89 ± 0.84) are significantly lower ($p < 0.001$; permutation test on group mean and variance differences) than those of modern humans (dm^1 's RET= 9.43 ± 0.87 ; dm^2 's RET= 13.84 ± 1.53). Accordingly, the RET index can be confirmed as an effective parameter distinguishing between modern human and Neanderthal upper deciduous molars.

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Ontogenetic development of postcranial adaptations to bipedalism in the rat.

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The evolution of bipedalism involved significant anatomical changes to accommodate a shift to supporting body weight only on the hindlimbs. Competing models for how bipedalism evolved suggest differing selection pressures for generating adaptive morphology. One way to assess these models is to clarify the relationship between form and function using an epigenetic model which relies on the inherent plasticity of musculoskeletal tissues during development in response to altered loading environments. In this pilot study, a novel method was used to experimentally induce a locomotor shift during ontogeny in an animal model for the quadrupedal-to-bipedal transition. Rats ($n=4$) were placed in a custom harness system mounted over a treadmill which allowed for comfortable bipedal locomotion at a Froude number of 0.25 over 60 minute periods. The harness imparts an adjustable upward force so that the load experienced by the hindlimbs can be altered. A quadrupedal control group ($n=4$) was exercised for the same period. Micro-CT scans were taken at bi-weekly intervals for all rats to obtain pelvic and lower limb dimensions and articular surface areas. Significant differences ($p < 0.05$) were found in femur length, the superior-inferior dimension of the femoral head, and the mediolateral dimension of the femoral condyles. Kinematic analysis comparing both groups walking bipedally demonstrates a significant increase in contact time for bipedal rats which is associated with reduced energy costs. This study demonstrates the possible role of developmental plasticity in the evolution of bipedal morphology. Implications of this study for the evolution of bipedalism will be discussed.

Variation in hair cortisol in wild anubis and hamadryas baboons and their natural hybrids.

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Cross-specific differences in endocrine function have been observed among primates, and may be related to variation in social environments and reproductive strategies. We examined cortisol levels in hair samples ($n=716$) from male and female anubis (*Papio anubis*), hamadryas (*P. hamadryas*) and hybrid baboons of the Awash National Park to see whether a) there were ontogenetic differences in adrenocortical function and b) signs of the effects of severe drought. Anubis baboons tend to have lower hair cortisol concentrations than hamadryas and hybrid baboons. Moreover, analysis of external phenotype in hybrids finds a correlation between a more anubis-like appearance and cortisol levels, suggesting a biological basis for inter-specific differences independent of social environment. Ontogeny of adrenocortical function reflected differences in life-history trajectories, with hamadryas and hybrids showing a more precocial increase in

cortisol coincident with testicular development. Comparisons of drought and non-drought samples suggest a blunting in adrenocortical function in male and female anubis, hamadryas and hybrid baboons under severe chronic ecological stress. Overall female hair cortisol concentrations were significantly higher compared to males independent of rainfall. However, examination of species specific sex differences showed that anubis females did not differ from anubis males under non-drought conditions; under drought conditions anubis females had significantly higher hair cortisol concentrations compared to males. Hybrids exhibited the reverse pattern compared to anubis baboons under both non-drought, and drought conditions. These results demonstrate species and sex specific differences in stress biology, which have implications for understanding reproductive and life history tradeoffs in primates.

Hair samples collected during fieldwork supported by the Earthwatch Institute, New York University, Washington University, the Harry Frank Guggenheim Foundation, and the National Science Foundation. Analysis carried out with the support from the Lewis Cotlow Fund (2008 and 2010) and the National Science Foundation Integrative Graduate Education and Research Traineeship award (NSF IGERT – Award ID: 0801634).

A regression method for the timing of micro enamel defects.

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Previous studies of the age at formation of enamel micro defects (Wilson bands) have employed methods that often fail to account for hidden cuspal enamel, use older developmental standards, a standard tooth size, and an assumption of constant velocity. Here, we use a method that attempts to correct for these limitations, the most important being updating the choice of developmental standard and the assumption of constant growth velocity.

Crown heights were measured and enamel micro defects were identified and their locations measured at the dentine-enamel junction (DEJ) for 97 unworn canines from the New York African Burial Ground. The percentage of enamel formation at the enamel micro defect was used to determine its age at formation based on a three phase regression equation fitting the histologically determined canine development pattern found by Reid and Dean (2000). The age at formation of micro defects was compared to results obtained from older methods. All methods yielded similar peak frequencies at around three years of age. However, the new method has a much more pronounced central tendency and conversely lower frequencies of micro-defects at early and later developmental ages. The difference in shape of the distribution of enamel micro defects is most likely due to taking into account varying growth velocity in the formation of canine dental enamel.

Are all humans created equal? A multivariate approach to skeletal asymmetry.

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Traditionally, skeletal asymmetry has been analyzed through univariate analyses, specifically a ratio that converts measures of asymmetry into percentages. This method of data adjustment has been applied to fluctuating and directional asymmetries so as to remove the influence of body size and facilitate comparison of asymmetries in dimensions of a different size. Exploration of this model reveals that it violates the fundamental and often unrecognized assumption of ratios, namely that the variable of interest must be isometric with body size. Moreover, it is limited to assessing one parameter at a time.

This study measured the humerus, radius, femur, and tibia of 119 adult humans and applied the univariate ratio and novel multivariate methods. An examination of the ratio model revealed that it does not fulfill its intended goal of correcting for body size, as the numerator and denominator are independent. A multivariate methodology using Principal Components Analysis and Euclidean distances was developed with the benefit of quantifying size and shape asymmetries, weighing the contributions of each, and looking at overall asymmetry in one analysis rather than variable by variable. This also enabled the direct analysis of both fluctuating and directional asymmetries. The independence of the principal components and separation of asymmetries dependent and independent of condition makes it appropriate for testing for fluctuating asymmetry, size-related directional asymmetry, and directional asymmetry due to robusticity. This approach reflects meaningful differences in overall asymmetry and the individual types of asymmetry while simplifying the analysis and interpretation and reducing the total number of analyses.

Right-handedness in Regourdou 1.

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The long known connections among handedness, brain asymmetry and language in living populations serve as a proxy for estimating brain lateralization and language capacity in the fossil record. Separate studies of skeletal elements and isolated teeth have shown that Neandertals were mostly right-handed, but we document for the first time handedness in a Neandertal skeleton with associated arms and dental remains. Regourdou 1, discovered in 1957 in a collapsed rock shelter in SW France, consists of complete mandible and primarily parts of the upper torso. Using the synchrotron

we quantified right/left differences in a variety of biomechanical measures and confirmed previous work, which identified Regourdou 1 as a likely right-hander. In the associated mandible the incisors are heavily scored with oblique scratches, primarily of the right-hand type. The concordance of arm and dental evidence for handedness in Regourdou 1 links activities directed by asymmetrical arm/hand movements with the traces of the activities left on the teeth. Regourdou 1 was lateralized and predominately right-handed like living humans. This and other evidence from archaeology to paleogenetics clearly establish language capacity in Neandertals.

Fallback food consumption and sympatry in *Eulemur coronatus* and *Eulemur sanfordi*.

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The presence of fallback foods (FBFs) may contribute to sympatry among crowned lemurs (*Eulemur coronatus*) and Sanford's lemurs (*Eulemur sanfordi*) in northern Madagascar. To examine these lemurs' habitat use, I compared a yearlong study conducted in Mt. d'Ambre, a large protected primary forest, with broad survey observations collected over the last six years in 28 unprotected forest fragments. In Mt. d'Ambre, the lemurs' consumed *Lantana camara*, a filler FBF, but I found no staple FBFs (Marshall and Wrangham 2007). *Lantana* was available year round, and made up to 25% of both lemurs' diets. In comparison to Mt. d'Ambre, the forest fragments were smaller, more secondary, and were usually dominated by one of two FBF species, either *Lantana* or tamarinds (*Tamarindus indica*). In *Lantana* fragments, lemurs were most often observed foraging near preferred fruit trees, including figs, and likely spent a large percentage of time in mango trees and near humans. In tamarind fragments, lemurs were readily observed eating ripe tamarinds both day and night. Both lemurs were also easily observed foraging and feeding in non-tamarind areas. Overall, when the lemurs did not consume FBFs, they partitioned their habitat much as they did in the primary forest. Although fewer lemurs were found in forests that did not contain both FBFs and preferred foods, anthropogenic factors are affecting the presence of both lemurs in this region. The presence of FBFs may enable both lemur species to co-occur in more forests than previously thought.

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Middle Pleistocene human facial morphology.

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The facial morphology of the middle Pleistocene humans is mosaic-like variously aligning them to *Homo erectus sensu lato*, *H. neanderthalensis* and *H. sapiens*. Facial features that foreshadow the "classic" Neanderthal morphology have been equivocally identified in the European middle Pleistocene humans (e.g., Arago 21, Petralona) but are absent in their African and Asian counterparts. Additionally, significant changes in facial size and robusticity occurred throughout Pleistocene human evolution. However, it is unclear how size affects facial features.

The goals of this study are to 1) seek to identify temporal trends that are potentially informative about ancestral or derived features; and 2) assess the effects of ontogenetic and static allometry on the Pleistocene human face. The modern human sample (N=259) comprises cross-sectional growth series of four morphologically distinct human populations; their ages range from two years to adulthood. The fossil sample covers human specimens from the early Pleistocene to the Upper Paleolithic, and includes several sub-adult fossil humans. We digitized landmarks and semilandmarks on surface scans and computed tomography scans and analyzed the Procrustes shape coordinates.

We show that species and population specific facial features develop before two years of age. Facial features can be used to separate Pleistocene humans into temporal clusters. Our results indicate the large-scale facial differences between Neanderthals and middle Pleistocene humans are mostly due to allometric scaling along a shared allometric trajectory and that certain features in the European middle Pleistocene human face are more similar to the "classic" Neanderthals than in the African or Asian representatives.

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Estimation of femoral second moments of area from shaft's external dimensions (AP and ML diameters).

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In recent years, bioarcheology witnessed an increase in interpreting past human behavior through biomechanical analyses. There are several methods either for direct derivation of cross-sectional properties (CT) or their estimation (latex cast, ellipse model methods etc.). However, these could be either laborious (casting) or not readily available (CT), especially for larger samples. Pearson et al. (2006) came up

with regression equations for estimating the Polar moment of area (J) at midshafts of several long bones from their AP and ML diameters. Here, we take up on this by providing estimation equations for J at several femoral cross-sectional locations. Multiple locations have been chosen due to our understanding that the femoral midshaft may not be the best location for behavioral inferences. We obtained femoral CT scans for 206 individuals from Early Medieval to Modern period of the Central Europe (Czech Republic). AP and ML diameters were recorded from the CT slices in the BoneJ plugin for ImageJ in all individuals and for a portion (n=71), the two measurements were also gathered manually with digital caliper for error comparison between manual and computer derived data. Multiple regression analyses were performed on raw and log transformed data. Estimation equations will be provided for the interval from 20 to 80 % of femoral biomechanical length in 5 % steps (13 equations). Here, we provide an equation for the midshaft in raw ($J = -120859 + 3121*AP + 2929*ML; \pm 3648.7; R^2=0.94$) and natural log transformed data ($\ln J = -1.99417 + 1.9126*\ln AP + 1.91231*\ln ML; \pm 0.06953, R^2=0.96$).

In poor families mothers' milk is richer for daughters than sons: an example of Trivers-Willard effects on mother's milk in northern Kenya.

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The Trivers-Willard hypothesis predicts unequal parental investment between daughters and sons depending on maternal condition and offspring reproductive potential. Specifically, it predicts that given higher reproductive variance in males, mothers in good condition should invest more in sons than daughters while mothers in poor condition should invest more in daughters than sons. For human parental investment, milk synthesis is energetically costly, yet variations in milk synthesis in relation to the offspring's sex are poorly understood. This study tests the Trivers-Willard hypothesis on human milkfat concentrations. Data from exclusively breastfeeding mothers (n=72) in Ariaal agro-pastoral villages of northern Kenya were used to test the hypothesis that economically sufficient mothers will produce higher milkfat for sons than daughters while poor mothers will produce higher milkfat for daughters than sons. A linear regression model was applied, using log transformed milkfat as the dependent variable, and offspring's sex (Son=1/Daughter=0), wealth status (Poor=1/Not poor=0), and the sex-wealth interaction as the predictors. The model controlled for maternal age, parity, postpartum time, body mass index, dietary fat intake, breastfeeding frequency, and household composition. Results supported the hypothesis: offspring's sex and wealth interacted ($p=0.002$) with milkfat. The model estimates that

economically sufficient mothers produce richer milk for sons than daughters (2.6 vs. 1.5 g/dL) while poor mothers produce richer milk for daughters than sons (2.3 vs. 2.0 g/dL). Further research on the variation in milkfat in relation to the offspring's sex is warranted.

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Toward a more perfect photogrammetry: accurately measuring physical traits of free-ranging animals.

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Assessment of variation in physical traits such as skeletal length, intermembral index, and numerous cranial and postcranial dimensions, is fundamental to many studies relating to systematics, locomotion, energetics, development, competition, and sexual selection (to name only a few). As many researchers have noted, however, accurately measuring size of physical traits of animals in the wild can be extremely challenging. Restraining wild animals can be difficult, dangerous, and expensive, and is likely to adversely affect other aspects of a study. We examined recently described non-invasive methods of measuring free-ranging animals and found a convergence on photogrammetry – using photographs of subjects to estimate body size based on mathematically inferred scales. In several studies, the mathematical principle, equipment, and methods employed were extremely similar. However, in published results as well as our own replication of methods, we found that error frequently exceeded 3% and thus risked obscuring inter-individual differences. We developed and tested a refined method of photogrammetry that is simple to use, affordable, and is appropriate for field studies of primates. In comparisons of actual size to estimated size, there was a mean error of 0.7% with a range of 0-1.9%.

Population health in fragmented forests: dry season variations in stress and parasitism in the *Lemur catta* of Madagascar's central highlands.

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Stress and parasitic profiles of a species can be sensitive indicators of its changing health ecology, particularly in the face of habitat alteration. We assessed these health parameters in populations of *Lemur catta* inhabiting two isolated fragments in south-central Madagascar – Anja Reserve and the Tsaranoro Valley forest. We investigated whether there were between-site or sex differences in stress hormone (corticosterone, CORT) levels in the 2009 dry season, or between-site differences in parasite infection for both 2009 and 2010 dry seasons.

Fifty fecal samples were collected for each season, with equal numbers of samples representing each site and sex. A portion of each sample was fixed in PVA solution for parasite analysis; the remainder dried and ground for CORT extraction. We found no differences in CORT levels between sites or sexes. Nematodes were found in 16% and 19% of our 2009 samples from Anja and Tsaranoro, respectively, while protozoa infection was detected in 12% (Anja) and 7% (Tsaranoro) of samples. The prevalence of parasite infection was higher in 2010, as 25% of samples from Anja and 63% from Tsaranoro contained nematodes, and this was also a significant between-site difference. We found no between-site difference in protozoa infection in our 2010 samples (63 vs. 52%); however, samples from Anja contained a higher parasite richness (5:1). We suggest that differences in foraging strategies, food resource distribution, and prevalence of heavy tourism at Anja may help to explain the within and between site differences in parasite loads/richness.

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Population health in the early colonial *reducción* of Magdalena de Cao Viejo.

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Recent research (Klaus and Tam 2009; Murphy et al. 2010) at early colonial sites in Peru is beginning to elucidate the breadth and depth of the influence of Spanish contact on native Andean populations. Excavations led by Jeffrey Quilter of the Peabody Museum at Harvard, have been proceeding at the site of Magdalena de Cao Viejo, an early colonial *reducción*, since 2004. In the 2007 and 2008 seasons, 25 burials were excavated from under the floor of the church and the adjacent cemetery. The recovery of these burials helped define changes in mortuary patterns that are consistent with Christian influence, although remnants of textiles wrapped around the bodies suggest a mix of Christianity with native traditions. Osteological analysis of the skeletal materials has allowed for a preliminary estimate of population health and the results indicate generally poor health, which supports the hypothesis that Spanish colonization negatively impacted native population health. Childhood mortality rates are high as are frequencies of trauma associated with physical labor (e.g., timpline deformation, spondylolisthesis), and non-specific indicators of stress, such as anemia. The results of these analyses will be presented and discussed within the context of the biocultural impact of Spanish occupation on native populations.

Ontogenetic diaphyseal shape correspondences in the human lower limb.

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A logical expectation of bone functional adaptation is that the external geometry of long bone diaphyses at different loci evidence poor covariance. Previous analyses of lower limb a-p/m-l diaphyseal indices in *Homo sapiens* confirm no correlation of length and specific a-p/m-l proportions. Buxton (Buxton 1938), directly assessed correspondences in a-p/m-l indices in associated elements and found a moderate correlation ($r = 0.4441$) of diaphyseal flattening in the femur and tibia. A large global sample of femora ($n=392$) confirm a low, yet significant, correlation of pilasteric and platymeric indices ($rho = 0.367$; $P < 0.001$) with minimal contrasts in males and females. Not surprisingly, a-p/m-l indices of the tibial midshaft and proximal diaphysis were substantially higher, with minimal sex-specific contrasts.

Pooled-sex specimens encompassing an age-at-death of ~ 32 weeks in-utero to ~ 10 years evidence a low (significant) correlation of femur length and a-p/m-l indices, yet no correspondence in pilasteric and platymeric indices. Contrastingly, tibial a-p/m-l proportions are insignificantly correlated with length, but midshaft and proximal a-p/m-l indices are highly correlated. Diaphyseal cross-sectional areas of the lower limb are strongly correlated with length and confirm the latent plasticity of femoral diaphyseal form, particularly its proximal aspect. In contrast, external tibial diaphyseal geometry is highly constrained during ontogeny and in adulthood. In contrast with adults, a-p/m-l dimensions of femoral and tibial diaphyses converge on expectations of Elastic Similarity Scaling (LSR) with overall length.

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Ancient DNA reveals the population origin of the Eastern Xinjiang.

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Connecting with the Turpan Basin, the Eurasia steppe and the Gansu Corridor, the Eastern region of Xinjiang has played a significant role in the history of human migration, cultural developments, and communications between the East and the West. The population origin, migration and integration of this region have attracted extensive interest among scientists.

In order to research the population origin and movement of the Eastern Xinjiang, genetic polymorphisms studies of the Hami population were conducted. The Hami site is located in the East of Tian-Moutain in Xinjiang, dating back to the Bronze-early Iron Age. Archaeological studies showed that the culture of the Hami site possessed features from both the East and the West. Ancient mtDNA analysis showed that A,

C, D, F, G, Z and M7 of the Eastern maternal lines, and W, U2e, U4, and U5a of the Western maternal lines were identified. Tajimas' D test and mismatch distribution analysis show that the Hami population had experienced population expansion in recent time. The demographic analysis of haplogroups suggests that the populations of the Northwest China, Siberia and the Central Asia have contributed to the mtDNA gene pool of the Hami population.

Our study reveals the genetic structure of the early population in Eastern Xinjiang, and its relationships with other Eurasian populations. The results will provide valuable genetic information to further explore the population origin and migration of Xinjiang and Central Asia.

The use of route-based mental maps for foraging in wild Bolivian saddleback tamarins.

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In this study we examined the ability of wild saddleback tamarins (*Saguinus fuscicollis weddelli*) to integrate spatial information in foraging decisions. We collected data on one group of tamarins for 4 months in 2009 and in 2011. During the 2011 field season, we also set up 3 feeding platforms located 124-191m apart in the group's range. In total, we collected data on the group's travel routes and on the sequential use of feeding sites during 40 complete and 12 partial observation days. We considered plant species that formed $\geq 1\%$ of the diet to be major food sources and we mapped the location of the individual trees of these species. We also recorded the location of the study group at 10 min intervals using a GPS unit, and used GIS software to analyze these data. In total the monkeys used 100 major feeding sites from 13 species, but only 2 of these species and 7 feeding sites were used in both years. Our results indicate that the tamarins used a limited set of nodes to reorient travel (N=9 in 2009, n=6 in 2011) and a larger set of route segments (N=29 in 2009, n=26 in 2011) to move between feeding sites. In addition, there was little overlap in the routes and nodes used between years. Overall, our results indicate that the tamarins employed a route-based mental map to navigate between feeding sites, and this map changed over time in response to changes in the distribution and availability of food resources.

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Strangers among them: using stable C, N, and S isotope analysis of human bone to interpret four unusual burials at the Yukisma Mound (CA-SCL-38), in Santa Clara County, California.

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ERIC J. BARTELINK¹ and ANTOINETTE MARTINEZ¹. ¹Anthropology, California State University, Chico, ²Anthropology, San Jose State University, ³Chairwoman, Muwekma Ohlone Tribe.

The Yukisma Mound (CA-SCL-38) in Santa Clara Valley, California, is a mortuary site used during the Middle/Late Transition and Late Periods, between 250 and 1700 years B.P. Of the 243 discrete gravelots identified, only one multiple burial was found, containing the skeletal remains of four young males. One (B141) was placed on his side in the traditional flexed position. The other three (B142, B143, and B144) were extended with limbs splayed. Embedded obsidian points were found in both B142 and B143, and another was closely associated with B144. B144 displayed possible cut marks on the medial aspect of the right distal humerus and right proximal ulna, in a pattern consistent with trophy taking; however, all long bones were present and intact.

To determine whether these individuals were likely part of the local population, stable carbon and nitrogen isotope values from their bone collagen and apatite were compared to other individuals from CA-SCL-38. $\delta^{13}\text{C}$ values of bone collagen and apatite were within the range of the population, but mean $\delta^{15}\text{N}$ of the four males was comparatively depleted by $\sim 2\%$. Bone collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values were found to co-vary in CA-SCL-38 adults (n=98; $r^2 = 0.772$). However, standardized residual values for these four males were more than three standard deviations below the population regression line. Sulfur isotopes were also used to assess geographical origin of the four individuals. Evidence suggests that these males were likely outsiders, raising additional questions about the circumstances surrounding this burial.

Directional shifts in humeral cross-sectional asymmetry during ontogeny.

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Asymmetry in humans has both genetic and environmental origins. In adults, post-cranial bilateral asymmetry has been related to environment and mechanical loading, most notably in upper limb bone cross-sectional properties. However, few studies have addressed the ontogenetic timing of asymmetric diaphyseal cross-sectional properties specifically, with one problem being potentially large relative measurement errors in small juvenile bones when using radiography to reconstruct sections.

Measurement error for sub-adult humeral diaphyseal cross-sectional properties was assessed using a sample of archaeological juveniles (n=20) by comparing pQCT derived properties and those reconstructed using bi-planar radiography and external molds. Errors were acceptable and similar to those reported for adults (mean humeral %error: 1.92%; mean Coefficient of Reliability: 0.99).

The x-ray and molding technique was then used to examine the ontogeny of humeral

directional asymmetry in humeral cross-sectional diaphyseal properties (n=103), as well as length (n=107), metaphyseal (n=60) and articular dimensions (n=53), from a well-age-distributed British cemetery assemblage, Barton-upon-Humber (ca. 950 AD to 1849 AD). The sample (perinatal to young adult) was subdivided into age cohorts for analysis. It was predicted that asymmetry would shift throughout growth, with right-biased laterality developing during childhood with the establishment of handedness.

Results indicate that left-sided humeral asymmetry is more prevalent during infancy and young childhood, with right-bias emerging during middle childhood for cross-sectional properties (5-10 years; $p < 0.00001$), while asymmetry in length ($p < 0.01$), metaphyseal and epiphyseal dimensions emerge in later development (10-18 years; $p < 0.05$).

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Assessing the impact of the Havasupai lawsuit on genetic research studies.

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Lawsuits and policy changes involving human genetic research have generated increased attention in recent years. In 2004, the Havasupai Tribe filed a lawsuit against Arizona Board of Regents and Arizona State University researchers when they discovered that their DNA samples, initially collected for genetic studies on Type II Diabetes, had also been used in multiple genetic studies without explicit approval from the tribe. The lawsuit resulted in a settlement in April 2010 in which tribal members received \$700,000 for compensation, funds for a clinic and school, and return of DNA samples.

Through semi-structured interviews with Institutional Review Board (IRB) chairpersons and biomedical researchers engaged in human genetics research, I examined the impact of the Havasupai lawsuit on human genetic research. Through these interviews, I have identified key concerns and reflections of IRB chairs and researchers on the current state of genetic research involving human subjects and on issues that were raised in the Havasupai lawsuit. My results suggest that the lawsuit has drawn attention to indigenous concerns about genetic studies and that it has increased awareness of indigenous views among researchers and IRBs. My interviews also reveal thoughts from IRB chairs and researchers about how the practice of science has changed, and highlights issues of informed consent, data-sharing, and secondary uses of samples. Overall, concerns about obtaining informed consent from individuals, groups, and indigenous communities pose questions about what constitutes proper consent and present new and expanded ways to engage participants in research.

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The effects of living conditions on human cranial and postcranial sexual dimorphism.

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Previous studies suggest that environmental variables differentially affect male and female body size, resulting in decreased sexual size dimorphism in samples under stressed conditions. In comparison, research investigating the relationship between living conditions and craniofacial trait dimorphism is lacking. Given that conspicuous craniofacial traits are not as costly to maintain and play a significant role in mate preferences, craniofacial trait dimorphism may be expected to either remain constant under stressed conditions, or possibly increase due to greater sexual selection pressures.

This study tests these two hypotheses by evaluating sexual dimorphism in body size and two specific cranial traits, the browridge and chin, across an array of diverse populations (13 samples, total $n = 670$). Genetically similar, yet environmentally varied paired samples are included to better isolate the effects of living conditions from population differences. Postcranial size dimorphism was calculated using traditional osteometric methods. In order to compare sexual dimorphism in the browridge and chin morphologies across groups, 3D surface scans were collected, and a method developed to objectively isolate the brow and chin segments. Transects and semi-landmarks were extracted from each segment for morphometric analyses. Dimorphism was calculated as the distance between male and female centroids in shape space. Results indicate that when all samples are pooled, there is a general positive relationship between body size dimorphism and craniofacial dimorphism. However, when specific paired samples are compared, only dimorphism in body size decreases in the more stressed samples, with no consistent trend in cranial trait dimorphism.

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Competing models of language evolution: what counts as evidence?

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Whether language emerged suddenly in approximate synchrony with the Upper Paleolithic, suddenly at another point in time, or gradually over an extended period remains a matter of debate. Questions of how to define language, protolanguage, symbolism, and syntax profoundly influence evolutionary perspectives as do competing scientific frameworks regarding the degree of behavioral localization in the brain and the nature of the genetic changes needed to instill linguistic capacity. Profound disagreements also center on interpretations of fossil and archeological data. Some infer the presence or absence of language from the presence or absence of symbolic art or complex tools. However, some fully linguistic modern societies create little in the way of non-

perishable artistic or technological remains, and clear links have yet to be shown between syntax and art, complex tools, or handedness. One bright point has, however, emerged. Linguists are now developing sophisticated models of how language could have evolved. It is time for others to develop equally sophisticated models of what we can actually determine about language from archaeological and fossil remains. This paper briefly discusses this issue from the perspective of comparative animal and human data on lateralization, complex object manipulations, and communication.

Evolutionary life history and the impact of a development intervention project on out-migration in rural Ethiopia.

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Rural development initiatives across the developing world are designed to improve community well-being and livelihood, however demographic consequences are rarely considered. Using evolutionary life history theory we investigate whether the introduction of a recent rural development initiative has been the catalyst for an increase in young adult out-migration in rural Ethiopia. Out-migration is a useful indicator of offspring investment in this population experiencing high growth rates and declining resource availability, where not all children inherit land and there are few other income-generating opportunities. Previous research has revealed that the intervention scheme, which improved maternal health and child survival through improved water supplies, has underpinned increases in family sizes (Gibson and Mace 2006) introducing greater scarcity of resources within the household. Using multi-level logistic event history modeling techniques we demonstrate that the initiative is also directly linked to increased out-migration of young adults to urban centres over a 15 year period ($n=3537$ 15-30 year olds). Out-migration for employment and/or education may represent a strategy of resource diversification for intensely competing offspring. We argue that it is the changes in the way parents chose to invest in their offspring which underlie variation in population levels across the world. We discuss the policy relevance of these findings and the long-term impact of migration in these communities.

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Unmasking the cryptic *Cercocebus/Mandrillus* clade in the fossil record: a new genus of Plio-Pleistocene African papionin from Ethiopia and Angola.

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Since its discovery 30 years ago, researchers have debated the systematic position of *Papio quadratiostris*, a large papionin cranium found in the Usno Formation of the Omo group, Ethiopia. While some have suggested that *P. quadratiostris* represents an early member of the genus *Theropithecus* (specifically a *T. brumpti* relative), others have argued that its original assignment to *Papio* was correct and have subsequently assigned a handful of specimens from the Omo Shungura and the Humpata Plateau of Angola to the *P. quadratiostris* hypodigm. At the time of these arguments, the genus *Papio* was generally understood to include extant mandrills, drills, and savannah baboons. More recently, however, both genetic and morphological data have instead demonstrated that mandrills and drills are most closely related to *Cercocebus mangabeys*; a number of features have now been documented differentiating the *Cercocebus/Mandrillus* group from savannah baboons, geladas and *Lophocebus mangabeys*.

In this new phylogenetic light, the current study re-examines the *P. quadratiostris* hypodigm from Ethiopia and Angola. Upon closer inspection, I identified a number of *P. quadratiostris* craniodontal morphologies shared exclusively with the *Cercocebus/Mandrillus* group. A comprehensive cladistic analysis including fossil and extant African papionins also supports a close relationship to *Cercocebus/Mandrillus*, broadly, or *Mandrillus*, more specifically. Because *P. quadratiostris* is neither closely related to *Papio* nor *Theropithecus*, the hypodigm requires a new generic nomen. Along with *Procercocobus* from Taung, South Africa, this new genus of African papionin represents some of the best evidence of the cryptic *Cercocebus/Mandrillus* clade in the fossil record.

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Catalytic cooperators: individual effects on hunting and patrolling among male chimpanzees.

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For chimpanzees, both group-level hunts of monkeys and territory defense appear to present a collective action problem. In both cases, cheaters (non-participants) may experience the benefits of success without paying the costs of joining the collective effort. Previous work at Kanyawara (Kibale National Park, Uganda) has shown that two particular males have a catalytic effect on group hunts. Here, using 32 years of long-term data, we show that the same phenomenon exists among male chimpanzees of the Kasekela community in Gombe National Park, Tanzania. Upon encountering potential prey (red colobus monkeys), a hunt was significantly more likely to occur if at least one of two 'impact' males was present in the chimpanzee party. This effect remained after statistically controlling for party size and the presence of sexually receptive

females ($\chi^2 = 7.17$, $p = 0.007$). We also report a significant temporal correlation between rates of hunting and border patrols ($r = 0.27$, $p < 0.0001$), which suggests that similar phenomena may affect both forms of collective action. We test this prediction by asking a) whether certain males are more likely to participate in patrols, and b) if these are the same males that catalyze hunting behavior. The results of this study have important implications for our understanding of the dynamics of cooperation in humans' closest living relative.

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Antemortem tooth loss and longevity in human evolution.

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Studies interpreting antemortem tooth loss (AMTL) in the human fossil record as evidence of more human-like behaviors or biology assume that modern humans have a higher frequency of AMTL than non-human primates. The single test of this assumption presented supporting preliminary data, but did not consider potentially confounding demographic variables such as age.

This study explores the effects of age and sex on AMTL in a skeletal sample of 486 human hunter-gatherers, *Pan troglodytes*, *Papio* sp., and *Pongo pygmaeus*. A binomial regression model with genus, age, and sex as main effects and an interaction effect between genus and age indicates that AMTL is less frequent in all three non-human primate groups than in humans even when accounting for age and sex. Age is an important predictor of AMTL, with each decade increasing the odds of AMTL by a factor of 3.0 (95 % CI: 2.3-4.0), but there is little to no evidence in the sample for sex or genus specific age effects on AMTL. The lack of support for genus specific age effects implies that differences in the pace of aging among genera are not significantly impacting AMTL.

These results corroborate the assumption that modern humans have a higher frequency of AMTL than do non-human primates and provide support for hypotheses that link AMTL to modern human behaviors or biology. The importance of age suggests that the high frequency of AMTL in modern humans may be explained in part by our increased longevity.

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Detailed measurements of primate calcanei from 3D models allow for reliable body mass estimation.

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Determining body mass is a fundamental step in understanding the paleobiology of fossil primates. Tooth size is the most commonly available proxy for body mass in fossil taxa. Certain tarsal bones are also abundant in the fossil record. Unlike teeth, postcranial articular surfaces of weight-bearing joints transmit forces that scale proportionally to body mass, therefore offering great promise for accurately predicting body mass. This study is the first to examine the calcaneus using surface area and volumetric measurements derived from 3D surface scans. A diverse set of calcanei was represented in this study, ranging from the smallest extant primate, *Microcebus*, to the largest, *Gorilla*, and including highly derived forms such as the specialized leaper *Tarsius*, and the slow climber *Nycticebus*. Linear regressions were created using four measurements of the calcaneus: total volume and surface area, surface area of the cuboid facet and surface area of the posterior calcaneal facet against average species body masses from the literature. Results showed that facet areas had the best correlations with body mass ($r^2 > .97$). Facet areas scale with positive allometry to body mass, indicating proportionally larger facets in larger taxa. Calcaneal volume and total surface area scale with slopes suggesting geometric isometry, but were less correlated ($r^2 > .93$), suggesting variation due to other factors (e.g., function and/or phylogeny). Body masses were estimated for several fossil platyrrhines, catarrhines and subfossil strepsirrhines and were found to be comparable to published estimates from dental and postcranial data sets.

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The Noua on horses? Rethinking the hypothesis of a horseback riding culture.

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The relationship between humans and horses has been important throughout history; it is a relationship that revolutionized travel and warfare. Because horse graves and bronze horse gear have been found within Noua sites, archaeologists have made the hypothesis that the Noua were a horseback riding culture. Individuals within a horse riding culture will exhibit certain indicators in the form of biomechanical bone changes and evidence for more trauma of the type associated with horseback riding than individuals from a culture where horses were not present or not used for riding. Using skeletal remains from known Noua cemetery, we tried to determine the degree to which, or indeed if at all, this specific population engaged in regular equestrian activities. Taken together the pathological along with the biomechanical indicators seem to indicate that habitual riding was not practiced by the individuals in this sample. Thus we propose that

the individuals in this specific sample were not riding horses. As for the occurrence of horse equipment among the Noua, an explanation may be sought in the fact that the equipment was unused and may therefore have been created for trade. The Noua were a metal working culture and therefore it is not unrealistic to infer that they used bronzes as trade goods.

The role of canine reduction in diagnosing the earliest hominins: lessons from a Miocene ape.

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Ardipithecus ramidus was diagnosed as a hominin largely based on changes to its C/P3 honing complex. These consisted of maxillary canine crown height reduction, an alteration in the morphology of the maxillary canine and mandibular P3, a decrease in sexual dimorphism of the maxillary canine, and a loss of honing. This diagnosis has been questioned given the apparent parallel evolution of canine crown height reduction in several late Miocene Eurasian hominoid taxa. The aim of this study was to evaluate whether the reduced maxillary canines possessed by *Oreopithecus bambolii* undermine the assertion that canine reduction in *Ar. ramidus* is phylogenetically informative.

We used phylogenetic comparative methods to determine whether or not *O. bambolii* possessed maxillary canines that are shorter than expected for a catarrhine of its estimated body mass. Canine reduction was also assessed in *Ar. ramidus*, *Australopithecus afarensis*, and *Au. anamensis*.

The canines of all three hominins were found to be shorter than expected for estimated body mass. The maxillary canines of *O. bambolii* are not shorter than expected for a catarrhine of its estimated body mass. This taxon retained substantial canine sexual size dimorphism, lacked the morphological changes to the maxillary canine observed in hominins, and retained a honing mechanism. Our results imply that the canine reduction present in *O. bambolii* was not homologous to that of the hominins. Based on these findings we suggest that canine size reduction is a character that may continue to be used to attribute taxa to the hominin clade.

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Age-at-death estimation in an historic Italian sample: a test of the auricular surface and transition analysis methods.

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Bioarchaeology has witnessed limited application of transition analysis for estimating

age-at-death in past populations. Working with ancient populations appears to restrict the relevance of the method due to difficulties in locating informative priors. Building upon our previous work, which demonstrated that both an informative and a uniform prior are appropriate with the Suchey-Brooks method in bioarchaeological contexts, this paper extends the same methodology to the Lovejoy et al. (1985) auricular surface aging technique.

A documented historic Italian sample from the island of Sardinia was scored for auricular surface aging (n=404). An informative sample (documented historic sample from Torino, Italy) and a uniform sample (Terry Collection) provided the priors. Transition analysis performed on the Sardinian sample caused us to collapse phases VII and VIII into one stage to generate appropriate ages-of-transition. Gompertz hazard parameters were calculated from each prior. The highest posterior density regions for each prior were computed and subjected to cumulative binomial tests to determine: 1) which prior performed better, and 2) how the priors performed in relation to the traditional auricular surface age ranges. Cumulative binomial tests showed the priors worked similarly in the females, while in the males the informative prior functioned slightly better. In both males and females, transition analysis using either prior out-performed the traditional auricular surface age ranges. The results here support earlier work by demonstrating both informative and uniform priors are appropriate for Bayesian analysis. Furthermore, applying transition analysis to bioarchaeological populations, utilizing either prior, will increase the accuracy of aging.

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Reconstructing Madagascar's vertebrate colonization history: a journey through time.

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Because there is virtually no Malagasy vertebrate fossil record between the Late Cretaceous and the Late Pleistocene, and because all but one of the vertebrate groups discovered in the island's rich Mesozoic deposits have left no descendants, the colonization history of Madagascar's vertebrates is knowable only indirectly. The number of vertebrate clades present on Madagascar during the Quaternary (excluding those that were introduced, deliberately or inadvertently, by humans) would

have depended on (1) vertebrate clade survival across the K/T boundary, (2) rates of colonization during the Cenozoic, and (3) rates of clade extinction. Some vertebrate clades must have existed for which we have no fossil record, but their number can be estimated using models of island biogeographic turnover and equilibrium. Such models may be crude, but for any conclusion that depends on them, we can estimate reasonable boundary conditions. Analyses of phylogenetic topology, especially when coupled with estimates of divergence timing, allow us to reconstruct the timing and area(s) of origin for many known Late Pleistocene/Holocene vertebrate groups. Using these analytical tools, and considering 81 Late Pleistocene/Holocene clades most of which descended from Cenozoic colonizers, we infer significant changes in the temporal patterns of colonization of different groups of Malagasy vertebrates, and we interpret them in the context of key geological, geophysical and oceanographic information. Most notably, the rate of arrival of terrestrial (rafting) vertebrates declined dramatically after the mid-Miocene, when ocean currents became less conducive to their arrival from Africa.

Energy demands of growth in Neanderthal children.

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Over the past several years, energetic approaches have been used increasingly to address key issues in Neanderthal ecology and evolution. However, previous work has focused exclusively on energy requirements of adults. The purpose of this paper is to use an energetics perspective to explore the distinctive patterns of growth and development and life history characteristics of Neanderthal children.

In this work we estimate basal metabolic rates (BMR; kcal/d) and total energy expenditure (TEE; kcal/d) of 10 young Neanderthals from birth to 6 years. Data on age at death and tibial and femoral lengths were collected from the literature. Height was estimated using published regression equations and reference data from contemporary circumpolar populations was used to estimate body weights and growth rates in Neanderthal children. Basal, growth, and total energy costs were then calculated drawing on reference data and equations from the WHO (FAO/WHO/UNU 1985, 2004). Energy costs associated with temperature stress were estimated using the predictive equations of Froehle (2008).

During few months after birth, Neanderthal children have higher TEE than modern humans of the same age. From that period onward, if the temperature adjustments are not included, Neanderthal children have lower BMR and TEE than their modern human

age peers (FAO/WHO/UNU 2004). However, when temperature stress is added, estimated BMR and TEE are markedly greater than the published average ones (FAO/WHO/UNU 2004). These findings underscore the severe thermal and metabolic constraints faced by Neanderthal infants and young children, and their implications for both growth and development and maternal energy allocation.

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The extent of rare, population specific genomic copy number variation: Implications for indigenous human populations.

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Copy number variants (CNVs) are DNA segments that vary in copy number among individuals and are surprisingly widespread in the genomes of phenotypically normal humans. In addition, CNVs functionally affect expression levels, susceptibility to certain common diseases, and intriguingly, local adaptations. Hence, CNVs may constitute a major portion of the genomic variation that contributes to heritable phenotypic variation among humans. Recently, several studies attempted high-resolution and comprehensive discovery of copy number variants among continental populations (e.g., Yoruba, representing African populations, and Caucasians from Utah (CEU) representing European populations), and found an excess of rare and singleton CNVs when compared to other types of genomic variants, such as single nucleotide polymorphisms (SNPs). For instance, in one recent study, we sequenced the genomes of 8 self-identified Koreans and uncovered 3,346 deletion CNVs mapped at nucleotide resolution. We revealed that more than 75% of these variants are population specific. In our preliminary analysis of the existing CNV data, we provide evidence that high *de novo* CNV formation rates, coupled with higher rates of purifying selection, contribute to the high rates of population-specific CNVs among humans. We further extrapolated our estimation to indigenous populations with different sizes and demographic histories. Taken together, we provide evidence that there is ample incentive for undertaking focused studies with well-contextualized sampling from local populations in order to discover population-specific variants that have had a phenotypic impact on extant human groups.

A genetic perspective on the evolution of longevity at the Middle Paleolithic to Upper Paleolithic transition.

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Fossil evidence indicates a marked increase in longevity, or the number of individuals living to be potential grandparents, between Upper Paleolithic (UP) populations in Europe and earlier Middle Paleolithic (MP) Neanderthals. The cultural implications for bi-generational learning and the timing at the MP/UP transition make this shift important to understand the uniqueness of the extended human lifespan and extensive culture. Multiple adaptive explanations have been suggested to explain this demographic shift, but it remains unknown if biological and/or cultural and ecological differences allowed for the increase in the longevity observed in UP populations. Here, we test the null hypothesis: Neanderthals and modern humans do not differ significantly at longevity associated single nucleotide polymorphisms (SNPs). We compared 29 longevity-associated SNPs in the Neanderthal consensus sequence with one modern human population, the CEPH European data from the HapMap. Next, we tested loci that differ in modern human populations and the Neanderthal consensus sequence for signatures of natural selection using standard statistical tests that detect departures from neutrality. Genes showing evidence of strong recent selection in the modern populations could indicate differences between modern humans and Neanderthals, or between modern humans and UP European populations. These results contribute a genetic perspective on the evolution of longevity during the MP/UP transition.

Trigonid talonid height and dental shearing in a sample of euprimates.

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With the loss of the paraconid among the euprimates, there has been a reorganization of the tooth crown resulting in an overall reduction of the trigonid and expansion of the talonid basin. This project explores the relationship between trigonid and talonid height, shearing and dietary categories across a broad sample of primates. Buccal shearing crests 1-4 length and protoconid and hypoconid height were measured on m1. Shearing quotient (SQ) was calculated as residuals from a frugivore-based regression line of the log summed length of shearing crests regressed against the length of m1. SQ was calculated for crests 1-4, and 1-2 (trigonid), 3-4 (talonid). Relative height indices (RHI) were calculated as (hypoconid height * 100) / protoconid height.

RHI can distinguish primates of different dietary category with frugivores having the broadest range of RHI values. This perhaps indicates a release of selective constraints on this trait in frugivores. The partially insectivorous *Saimiri* can also be distinguished from other genera based on RHI. When RHI was compared to SQ 1-2, 3-4, no significant relationship was found. All measures of SQ were able to distinguish frugivores, folivores, and insectivores suggesting that SQ measures calculated from a small sample of crests are still a useful measure for determining dietary category in incomplete fossil specimens. Interestingly, SQ 3-4 was better able to distinguish different species from

each other than SQ 1-2 perhaps indicating a stronger phylogenetic component to shear crest length in the talonid than the trigonid.

Nutritional stress and the pattern of fluctuating asymmetry in the skull.

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The environment experienced throughout ontogeny plays an important role in shaping the patterns of phenotypic variation within and among individuals. Particularly, stressful factors are thought to affect the mechanisms that buffer the development, resulting in an increase of phenotypic variance. In this study we examine the effect of an environmental stressor, protein-caloric restriction, on levels of disparity and fluctuating asymmetry of the skull shape. The experimental design consisted in the application of different levels of nutrient restriction during postnatal life to four groups of Wistar rats. Sixty two 3D landmarks from both sides of the skull were digitized on micro CT-scans obtained from animals aged 63 days. A two-way mixed model ANOVA was applied to the coordinates after Procrustes superimposition in order to simultaneously estimate the amount of fluctuating (FA) and directional asymmetry. FA scores for each individual were calculated and used for testing the differences in FA between treatments. The sum of the Euclidean distances between individuals along the principal component axis was used as a measure of within group disparity. We found that the early nutrient restriction led to a significant increase of shape disparity. In addition, FA was significant higher than measurement error and accounted for between 10 to 17% of the total shape variation within-groups in the face, base and vault. However, no effect of stress on levels of FA was found in either module of the skull. The implications of these results are discussed in the context of human population studies.

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Variation in bone mineral density of the proximal femur: It is not just about age and sex.

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Changes in bone mineral density (BMD) over a lifetime increases the risk of fractures. More than 40 million people in the United States suffer from low BMD. Older women of European descent are most at risk of developing hip fractures due to low BMD. Even though researchers recognize BMD variation in different populations, BMD averages do not account for other patterns of variation, such as regional variation, in human populations.

This study presents evidence of regional variation in the BMD of the femoral neck,

intertrochanteric region, and shaft of Americans of African and European descent. Data consisting of a sample of 9,416 individuals from NHANES III were analyzed by means of a discriminant function analysis to show patterns of variation unique to the northeastern, midwestern, southern, and western regions of the United States. All data were collected by the National Center for Health Statistics using a Hologic DXA scanner and a hip structural analysis program.

The results of the analysis demonstrate variation in the rate of speed and quantity of BMD loss. Males of African descent and females of European descent living in the northeast exhibit the fastest BMD loss whereas males of European descent exhibit the fastest BMD loss in the west. Women of African descent show more equal distributions of BMD in all regions. However, when considering BMD quantity, males of African and European descent show the greatest loss in the Midwest. In females, women of African and European descent show the greatest BMD loss in the Northeast.

Ecological effects on sexual dimorphism: Sex-specific body mass response to climate variables in wild populations of eastern sifakas.

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It has long been recognized that sexual dimorphism is influenced by factors other than sexual selection alone. One such potential factor is a differential response of male and female body size to resource availability due to the metabolic demands of pregnancy and lactation. If true, female body mass may vary more across populations in relation to environmental variables than male body mass. Lemurs are well-suited to investigations of this hypothesis in that (1) lemurs are endemic to an isolated land mass with wide climatic variability and (2) the limited dimorphism present within lemur species is not correlated with sexual selection.

Sex-specific body mass and locality data for 19 wild populations of eastern *Propithecus* were drawn from a database of observations from over 3500 wild lemurs accumulated since 1999 by the Center for Conservation and Research. Populations included in this study lived in the eastern humid forests of Madagascar from 12.8 to 21.3 degrees south in latitude, and at elevations from 200 to 1300 meters above sea level. Precipitation and temperature data for each population were estimated using the WorldClim global climate database. Male and female body size were both found to be significantly positively correlated with annual rainfall across populations at alpha = 0.05. Female regressions slopes were higher than male slopes, consistent with a greater response in female size to environmental variables, although the difference in slopes was not significant. Future work will use the CCR database to test this hypothesis across a broader collection of environments and taxa.

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An assessment of Bayesian methods for ancestral state estimation.

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Recent studies have attempted to investigate evolutionary trends by utilizing ancestral state reconstruction (ASR) to reconstruct ancestral morphology from phylogenetic variation of extant descendants. However, simulation studies question the precision of ASR because the models often specify a component of theoretical error resulting in 95% confidence intervals that exceed the range of values in the extant distribution. We evaluate Bayesian methods for ASR using the relief index of the second lower molar of 57 eumarchontans including 26 strepsirrhines, 18 platyrrhines, two tarsiers, two dermopterans, two scandentians, five extinct euprimates, and two plesiadapiforms. We compared ASR for relief index in the ancestral euprimate using a phylogeny based on 1) extant taxa only, and 2) the entire sample. Analysis 1 reconstructed the euprimate node as having an index of 0.5348, a similar value to basal fossil euprimates, *Teilhardina asiatica* (0.5467) and *Donrussellia* (0.4994 - 0.5461). Although the 95% highest probability density (HPD) interval of the estimate is large (0.4683 - 0.5969) and prohibits unambiguous dietary reconstruction, it is still smaller than the observed range of the extant sample (0.3453 - 0.6383). Analysis 2 reconstructed the euprimate node as 0.5772, which is closest to the extant *Tarsius bancanus* (0.5755); the 95% HPD interval ranges from 0.5454 to 0.6088. This analysis narrows the HPD interval enough to unambiguously reconstruct the ancestral euprimate as an insectivore, indicating the importance of including extinct taxa in ASR studies when possible. Future work will address how changing phylogenetic topologies and branch lengths of fossil species affect nodal reconstruction.

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Cooperative breeding and hominin brain size evolution: evidence from a comparative study in birds.

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Humans are characterized by huge brains and high reproductive rates in comparison to great apes, which we aim to explain using a comparative phylogenetic approach. Variation in brain size relative to body mass has been found to correlate negatively with reproductive rates in most mammals. Cooperatively breeding carnivores are the exception. This is interpreted as the effect of energy subsidies during breeding, which allow species with allomaternal help to alleviate the trade-off between energy used for reproduction and for brain growth and maintenance. Because the number of mammals with allomaternal care is relatively limited, we here report on a study of its correlates in over 600 bird species.

In addition to basic data on brain and body mass, life history variables and development types, we quantified the energy expenditure of each parent and additional helpers, and the combined input per offspring. We predicted that energy subsidies of nestlings affect brain size or fertility mainly in altricial birds, as brain growth occurs mainly between hatching and fledging in this group. However, we found a stronger effect of the total energetic input of caretakers in precocial birds, indicating the critical role of supporting adult-sized brains in relatively very small immature bodies. In sum, our results provide independent evidence for the cooperative breeding hypothesis, which postulates that a change towards a significant allomaternal component in child care stood at the beginning of the ever-increasing brain size of the human lineage.

Bipedalism, obstetrics, and the evolution of constraints.

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Differences in the pelvis between hominins and other apes are hypothesized to be primarily the result of selection for habitual upright locomotion. Hominins also possess an obstetric morphology that diverges from other apes and causes parturition difficulties in our own species. Because bipedalism and birth converge at the pelvis, later hominin and modern human obstetric morphology is hypothesized to be the result of a compromise between selective pressures for increased pelvic apertures, allowing for the birth of larger brained and bodied neonates, and pressures related to bipedalism. While biomechanical methods have been used previously, patterns of integration - covariances between traits - provide a new approach to this problem as these patterns reflect functional and developmental relationships and can reveal how one trait or set of traits constrains the evolution of another. The results here show that integration between obstetric and other hip traits in humans can constrain the evolution of the obstetric canal, but this relationship is likely ancestral for hominoids. Where humans differ from other apes is in possessing a significantly lower magnitude of integration within the birth canal, which allows the direction of the evolutionary response and the direction of selection to align to a

significantly greater degree than possible in other apes. These findings suggest that natural selection for increased obstetric dimensions in hominins compensated for evolutionary constraints due to locomotor requirements by reducing constraints within the birth canal, allowing for morphological evolution along a trajectory that might have previously been difficult or impossible to traverse.

Analysis of Chuvash mtDNA points to Finno-Ugric origin.

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A sample of 92 unrelated individuals from Chuvashia, Russia was sequenced for hypervariable region-I (HVR-I) of the mtDNA molecule. These data have been verified using RFLP analysis of the control region, revealing that the majority exhibit haplogroups H (31%), U (22%), and K (11%), which occur in high frequencies in western and northern Europe, but are virtually absent in Altaic or Mongolian populations. Multidimensional scaling (MDS) was used to examine distances between the Chuvash and reference populations from the literature. Neutrality tests (Tajima's *D* (-1.43365) *p*<0.05, Fu's *F_s* (-25.50518) *p*<0.001) and mismatch analysis, which illustrates unimodal distribution, all suggest an expanding population.

The Chuvash speak a Turkic language that is not mutually intelligible to other extant Turkish groups, and their genetics are distinct from Turkic-speaking Altaic groups. Some scholars have suggested that they are remnants of the Golden Horde, while others have advocated that they are the products of admixture between Turkic and Finno-Ugric speakers who came into contact during the 13th century. Earlier genetic research using autosomal DNA markers indicated a Finno-Ugric origin for the Chuvash. This study examines uniparental mitochondrial DNA markers to better elucidate their origins. Results from this study maintain that the Chuvash are not related to Altaic or Mongolian populations along their maternal line, thus supporting the "Elite" hypothesis that their language was imposed by a conquering group — leaving Chuvash mtDNA largely of Eurasian origin. Their maternal markers appear to most closely resemble Finno-Ugric speakers rather than Turkic speakers.

Stable thoracolumbar morphology: implications for terminal branch locomotion.

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A stable thoracolumbar region found in some arboreal mammals and certain primates has been proposed as the primitive euarchontan condition and advantageous for bridging and cantilevering between discontinuous terminal branches. However, no data exist testing the inferred link between osteological features cited as enhancing whole-body stability and the frequency and mechanics of cantilevering and bridging in a terminal branch environment. To fill this gap we compared costal and vertebral morphology of primate and nonprimate mammals thought to cantilever and bridge frequently to those that do not. We also contrasted the frequency and kinematics of cantilevering and bridging of *Caluromys philander* and *Loris tardigradus* (fine-branch specialists), to *Monodelphis domestica* (terrestrial quadruped) and *Cheirogaleus medius* (active arboreal quadruped) on a raised horizontal pole and terminal branch experimental set-up. We observed *C. philander* cantilevering and bridging significantly more often (55% of observed events) than *M. domestica*, which never cantilevered or crossed any arboreal gaps ($P < 0.001$). No difference in cantilevering frequency was observed between *L. tardigradus* and *C. medius*, but the duration of cantilevering bouts were significantly greater in *L. tardigradus* ($4.24 \text{ sec} \pm 2.11$ vs. $2.35 \text{ sec} \pm 1.71$; $P < 0.01$). Cluster analysis reveals that *C. philander* and *Loris* exhibit thoracolumbar stability related to reduced intervertebral and intercostal spaces, when compared to closely related species like *M. domestica* and *C. medius*. These data suggest that osteological stability, which may have been present in the ancestral primate, may be part of a complex that increases security in a terminal branch environment.

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Reading between the vertebrae – the presence of a non-embedded projectile point and subsequent consequences: a case study.

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Examination of the skeletal remains of an individual from the third Mission Santa Clara Indian Neophyte Cemetery, 1781-1818, CA-SCL-30H, provides a compelling case study. This individual had a unique bony response to an obsidian projectile point lodged in the intervertebral space between the twelfth thoracic and first lumbar vertebrae. An unusual bony ring formed that isolated the projectile point. As a result, several other elements displayed secondary trauma that led to possible disturbances of gait and asymmetric skeletal element responses. The formation of the bony ring stabilized the projectile point allowing for the individual to survive and continue functioning within the Mission population. The

presence of the bony ring with projectile point argues for the inclusion of documenting soft tissue injuries as interpersonal aggression even when the point is not embedded in bone.

Geometric morphometric assessment of pelvic sexual dimorphism in *Pan*, *Gorilla*, and *Homo sapiens*.

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Pelvic sexual dimorphism is closely linked to obstetric requirements in modern humans. Female pelvic morphology evolved to accommodate the delivery of neonates with head circumferences approximating the dimensions of the pelvic inlet, while human males and African apes of both sexes faced no such requirement. Early literature reported sexual dimorphism in the pelves of chimpanzees, but many recent studies refuted these initial claims. This study addresses these contradictions, using qualitative character states and three-dimensional landmark data to record and describe the shape of pelvic morphology specifically linked to obstetrics (the focus of most previous studies) and morphology that is presumably unrelated. Geometric morphometric techniques are used to assess a large sample of African ape and modern human pelves. Principal components analyses effectively separate chimpanzees and humans by sex, but gorilla specimens overlap in shape space. Canonical variates analyses successfully assign all specimens to the correct sex category for each species. Pairwise analyses of regression coefficient vector angles suggest significantly different patterns of variation between humans and chimpanzees and between humans and gorillas, but not between chimpanzees and gorillas. Character states for five qualitative traits used in forensic studies to sex human pelves are considered in African ape pelves. Analysis of these character states fail to separate male and female apes. Many of the sexually dimorphic characters identified in African ape pelves appear to be unrelated to parturition, requiring further examination in the context of phylogenetic history and functional morphology to elucidate the underlying explanations for their presence.

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Ontogeny of the catarrhine shoulder: the influence of behavior on morphology.

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Somatic growth is constrained by several genetic parameters, but other factors, namely, locomotor stresses, can also influence morphological development. Scapular shape is closely related to locomotor activity, so it is plausible that ontogenetic behavioral changes might similarly engender intraspecific morphological differences. To test this, the ontogeny of scapular morphology was examined

in taxa known to climb less frequently throughout development (*Pan*, *Gorilla*, and *Macaca*) and others that maintain a more stable locomotor pattern (*Pongo*, *Hylobates*, and *Homo*). If the development of some features corresponds with ontogenetic locomotor changes while also differing from the common developmental pattern displayed in other taxa, it would be reasonable to attribute the morphological shift to the aforementioned behavioral changes.

Suspensory hominoids were distinguished from *Macaca* and *Homo* by having more superiorly facing glenohumeral joints, obliquely oriented scapular spines, relatively narrow infraspinous regions, and expanded subscapularis fossae. Although some traits followed a generally common pattern of growth among all taxa, other features, like infraspinous fossa shape, did not change markedly within *Pongo*, *Hylobates*, or *Homo*, but became relatively broader throughout *Pan*, *Gorilla*, and *Macaca* ontogeny. This morphological shift deviates from the growth pattern observed in *Pongo*, *Hylobates*, and *Homo*, and also corresponds with what was predicted for such a transition to a less arboreal lifestyle. These results demonstrate that some scapular features may track subtle differences in locomotor behavior over the course of an organism's lifetime, and supports the use of these characteristics for reconstructing behavior, particularly in fossil forms.

Support for this research was provided by the National Science Foundation IGERT Program (99875690), an NSF Doctoral Dissertation Improvement Grant (BCS-0824552), and a Wenner-Gren Foundation Dissertation Fieldwork Grant.

You don't have a leg to stand on: a case study of femo-tibial fusion from a cave in the Andahuaylas Province, Peru.

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Medico-cultural interventions, such as amputation, show up frequently in skeletal samples from the Andes. This paper describes findings based on a palimpsest of pre-, peri-, and postmortem interventions performed on one individual; we hypothesize the circumstances which mediated these procedures. These remains, found in a commingled burial cave in Andahuaylas, Peru, pertain to an individual from the Chanka culture (ca. AD 1000-1400).

Based on metric and nonmetric data (diaphysis circumference, medial-lateral diameter, and transverse diameter), the fused element is a right leg from an adult male. Likely the result of traumatic etiology during adulthood, the distal femur and proximal tibia were immobilized after injury and eventually fused at the knee with a cancellous bone bridge at a ~130° angle. Twelve perimortem cut marks at the proximal end of the femur and 14 cut marks on the distal end of the tibia indicate thigh amputation, and foot amputation, respectively. "Chatter" cut marks on bone indicate possible postmortem defleshing, while bone polishing on amputated ends and on the cancellous bridge

suggest pot-cooking. Results suggest that the Chanka had social and technical measures in place to provide therapeutic interventions for individuals with limited mobility, as well as customs for dealing with disarticulated appendages.

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Residential mobility and social identity in the periphery: strontium isotope analysis of archaeological tooth enamel from southeastern Arabia.

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Strontium isotope analysis represents an effective means of assessing mobility and reconstructing geographic residence patterns in archaeological populations. This biogeochemical technique was utilized to test the hypothesis that burgeoning interregional exchange networks and the occurrence of exotic grave goods in local tombs would correspond with a highly mobile population and a considerable immigrant presence during the Umm an-Nar (2500-2000 BC) period in the UAE. This region has been considered peripheral relative to larger civilizations in Mesopotamia and the Indus Valley, but played an important role as a major supplier of copper for the Persian Gulf. Individuals (n=100) from six Umm an-Nar tombs (Mowaihat; Tell Abra; Umm an-Nar Island I, II, V; Unar 1) were selected to evaluate the geographic origins of tomb members.

Mean $^{87}\text{Sr}/^{86}\text{Sr}$ ratios from local individuals interred at Mowaihat (0.708863 ± 0.000014 ; 1σ , n=12), Tell Abra (0.708873 ± 0.000020 ; 1σ , n=27), Umm an-Nar Island (0.708902 ± 0.000079 ; 1σ , n=33), and Unar 1 (0.708805 ± 0.000065 ; 1σ , n=25) all display little isotopic variability indicative of a population that was not highly mobile. However, coupled with archaeological evidence, three immigrants from Tell Abra (n=2) and Mowaihat (n=1) identified by deviant strontium values suggest that this region was actively engaged in interregional interaction. Despite claims that these monumental tombs acted as visible markers of territoriality legitimized by ancestors buried within them, the presence of non-locals suggests that as commerce became increasingly important, definitions of kinship and social identity may have become more flexible to better meet the needs of the local community and those they interacted with.

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Diseases of early first Millennium B.C. mounted Pastoralists in the Kunlun Mountains, China.

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Paleopathological investigations on archaeological skeletons of the population of Liushui, Xinjiang, West China, dating to the early first millennium B.C. were carried out on 100 individuals. The skeletons were examined with macroscopic and optical-microscopic techniques.

Beside other afflictions, musculoskeletal diseases appeared in a high frequency. The highest occurrence of pathological processes is shown in the lower extremities, for example jumper's knee, tendinitis of the Achilles' tendon as well as tendovaginitis and rupture of tendons of the feet. Also calcaneal spurs could be found. Additionally, ruptures of ligaments of the ankle joints as well as myositis ossificans or stress fractures of the foot bones occurred.

In the upper extremities particularly the shoulder and elbow joints were affected: Epicondylitis as well as degenerative processes or rupture of the tendons of the shoulder joint and stress fractures of the acromion of the scapula occurred.

Many pathological changes are evidence for intensive horse riding: Fractures of vertebral bodies are caused by compressive stress over a long time period. Also arthrosis, especially in the lower parts of the spine, together with ligamentopathy could be a distinct indication of riding.

Paleopathological results as well as archaeological evidence define the population of Liushui as people involved in vertical mobile pastoralism with the resulting activities like extensive horse riding, walking and jumping with heavy loads, and archery practice from a very young age.

Constraints on sexually selected traits in a high-altitude tarsier species, *Tarsius pumilus*.

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Among primates, body mass differences between males and females associates with male-male competition and polygynous mating systems. However, degree of sexual dimorphism negatively correlates with lower quality environments. Resource-poor environments such as high altitude forest may constrain the evolution of sexually selected traits. For instance, while increased sperm competition is important in mating systems with multiple breeding males, environmental constraints may limit the development of larger testes. Under this hypothesis, both sexual dimorphism and testes size are expected to decline with increasing altitude. This study examines whether two sexually selected traits, sexual dimorphism of body mass and testes volume, match allometric and behavioral expectations for pygmy tarsiers (*Tarsius pumilus*), a high-altitude tarsier species.

Pygmy tarsiers have been observed to sleep in groups with more than one adult male, indicating they should experience more sperm competition than lowland populations where adult males do not associate. Data on primate body size and relative testes size were compared from a combination of published literature and unpublished data. Pygmy tarsiers do not show significant body mass differences between the sexes (n=15; Kruskal-Wallis: $\alpha=0.05$; $Z=0.7578$; $p=0.4486$). Compared to lowland tarsiers, pygmy tarsiers have relatively smaller testes volume, indicating less sperm competition. These results suggest a monogamous mating system among pygmy tarsiers, and may indicate these tarsiers experience less sexual selection pressures than lowland tarsier species in association with high altitude constraints. These results may be confounded by temporal changes in testes size, since mating season and seasonal effects are unknown in pygmy tarsiers.

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A bioarchaeological approach to interethnic contact in Tierra del Fuego, Argentina (19th-20th centuries).

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The analysis of the cultural and biological changes which came about in Southern Patagonia as a result of interethnic contact offers an interesting case study for bioarchaeologists dealing with colonial contexts in the Americas. The interdisciplinary research conducted at the cemetery of the Salesian Mission La Candelaria provides relevant information on the multiple interactions which took place among religious communities, native people and other social actors in Tierra del Fuego, in the late 19th and the late 20th centuries. Historical sources inform that tuberculosis was the major death cause among native people living in La Candelaria. The epidemiological history of Tierra del Fuego poses some questions about the origins and the spread of tuberculosis in Patagonia. In the site of Myren (Chile), archaeologists reported a possible case of tuberculosis dated to 640 ± 20 BP. In addition to this, researchers have recently found a kind of tuberculosis which can be transmitted from pinnipeds to humans. Starting in 2006, excavations at the cemetery of La Candelaria allowed the recovery of information from 21 individuals. Researchers are particularly interested in the characteristics of the burials and the paleopathological condition of the bodies.

The project has obtained seven stable-isotope determinations; and it is presently working on the molecular analysis of TB and haplogroups together with Anne Stone. The comparison with pre and post contact information proves relevant, and it is part of the research agenda. The project is also trying to preserve and enhance the history of La Candelaria, counting on the participation of local actors.

PICT 01520 (2007-10), PICT 0575 (2011-23) and CONICET.

Skull reconstruction of Barma del Caviglione 1, Grimaldi Caves, an Upper Paleolithic *Homo sapiens*.

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In 1872, in the Cavillon's Cave, a burial of an almost complete *Homo sapiens* skeleton was discovered: Barma del Caviglione 1. The burial was taken along in block to the National Museum of Natural History in Paris where it was exposed to the public as one of the main specimen of the Prehistoric collection. Recently, our team managed a multidisciplinary research on this famous fossil which was deformed and/or fractured, covered of ochre, shell's ornaments and partially full of matrix. Dating is about 24,500 years BP (C14).

We present here the first reconstruction of the cranium and the mandible. Data was gathered with a medical scanner (General Electric Light Speed, 0.299mm thickness, 120kV, 120mAs, 26.3cm FOV) and were exported as DICOM files (373*351) and postprocessed using Mimics 13.1 (Materialise©) and RapidForm 2006 (Inus Technology®).

The first stage consisted in cleaning bones of the ochre deposit, the ornaments and the matrix, slice by slice. Each fragment was then isolated before being connected with the others. The internal structures were modelised (endocranium, inner ear). The reconstructed skull was studied using metric as well as Procrustes methods and compared with Upper Paleolithic and more recent *Homo sapiens*.

Results bring new information on the Grimaldi Caves fossils and the variability of *Homo sapiens* from the Upper Paleolithic. It allows us to postulate the existence of a geo-chronological group characterized by anatomical and cultural peculiarities and symbolic behaviors.

From the womb to the tomb: the role of transfers in shaping the evolved human life history.

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Humans are the longest living and slowest growing of all primates. Although most primates are social, humans are highly

cooperative and pro-social in ways that likely co-evolved with the slow human life history. We highlight the role of resource transfers within and among generations in shaping low human mortality rates as a necessary precursor for selecting further reduced adult mortality rate in late adulthood. In conjunction with changes in the age-profile of production, the impacts of resource transfers and other forms of sociality on mortality may have played an important role in selection on post-reproductive lifespan during the course of human evolution. Using medical data and semi-structured interviews, I explore several types of common risks experienced amongst Tsimane forager-horticulturalists and quantify the types and targets of aid commonly given. Results illustrate the ubiquity of transfers in several key domains and suggest that the absence of transfers would greatly increase both pre-adult and adult human mortality rates.

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Locomotor morphology of *Theropithecus brumpti*.

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The cercopithecoid genus *Theropithecus* is often used as an analogue for human evolution. Due to preservation bias, much of our understanding of the paleobiology of *Theropithecus* is based on the grassland adapted *Theropithecus oswaldi*. In order to better understand the ecological breadth of the genus, a complete functional analysis of the postcranial material of the woodland associated *T. brumpti* is presented.

Contrary to previous findings, there is no evidence that *T. brumpti* was an arboreal primate. *Theropithecus brumpti* is clearly a terrestrial papionin. While *T. brumpti* retains a degree of flexibility (at the shoulder, elbow, hip, knee and ankle), this is not exceptional when compared to other members of the genus, notably *Theropithecus oswaldi*. Features historically used to reconstruct *T. brumpti* as more arboreal than other members of the genus are interpreted here as part of a suite of traits that characterize early *Theropithecus* including early *T. oswaldi*, which are mapped onto a terrestrial papionin morphotype.

Therefore, the suite of traits that characterize the genus may be related to manual manipulation and/ or food processing. Manual terrestrial foraging may have been primitive for papionin monkeys and so, these traits may be better interpreted as foraging adaptations related to forest floor locomotion and gleaning which may be primitive for *Theropithecus* and possibly for papionins. Further, if the common ancestor of *Theropithecus*, *Papio* and *Lophocebus* is arboreal, perhaps in the *Theropithecus* lineage the ability to manipulate arboreal environments was co-opted for fine manipulation of food objects on the ground.

This study of was funded by the Geological Society of America, the Paleontological Society, the National Science Foundation, the L.S.B. Leakey Foundation and the University of Oregon.

An odontometric investigation of the biological origins of the Baltis: a Tibeto-Burman speaking population of Northern Pakistan.

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The Baltis are a Tibeto-Burman speaking ethnic group who reside in northern Pakistan. Most authorities claim that Baltis have Tibetan origin, but Y-chromosome variations (Qamar et al. 2002) did not confirm this. Backstrom (1992) asserts that even if Baltis do have Tibetan origins, they experienced extensive admixture with local Dardic-speaking populations after their arrival in Gilgit-Baltistan.

This research identifies Balti origins through a comparative analysis of permanent tooth size allocation among 180 Balti young adults from Partuk, located in northern Pakistan. Maximum mesiodistal and buccolingual measurements were obtained for all permanent teeth, except third molars, in accordance with standardized methods. Individual measurements were scaled against the geometric mean to control for sex dimorphism and evolutionary tooth size reduction. These data were contrasted with 21 samples of prehistoric and living individuals from Pakistan, peninsular India, Central Asia, and the Iranian Plateau. Inter-sample differences in tooth size allocation were assessed with pairwise squared Euclidian distances, and the patterning of phenetic affinities among samples was assessed with neighbor-joining cluster analysis and principal co-ordinates analysis.

The results indicate that Baltis occupy an isolated phenetic position with some, albeit rather distant, affinities to other ethnic groups that occupy the rugged highlands of northern Pakistan. Baltis share no affinities to living peninsular Indians, or to prehistoric samples from Central Asia and the Indus Valley of Pakistan. These results are consistent with a scenario that calls for Balti origins among Tibetan populations, with some, but by no means extensive, admixture with local non-Tibetan Dardic-speaking populations.

Traumatic spinal injury in the KNM-WT 15000 *Homo erectus* skeleton.

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Back problems are omnipresent in modern humans and cause enormous health costs. This is often thought to be founded in the increasingly sedentary lifestyle of industrialized populations as well as in our upright, bipedal locomotion that places huge mechanical demands on the vertebral column. Little is known, however, of this situation during the course of human evolution. Here we analyse the lumbar spine of the *Homo erectus* boy skeleton KNM-WT 15000 from Nariokotome, Kenya. We identified facet joint subluxation at L4/5, but we found no evidence for scoliosis. This implies a chronic disc pathology that might have caused disabling backache and sciatica. This is unexpected at the juvenile age of KNM-WT

15000. In contrast to adults, important risk factors for disc lesions in adolescents are the pubertal growth spurt and trauma. Our results suggest that the lifestyle of *Homo erectus* was physically very demanding and /or their vertebral column was not as adapted to bipedal locomotion as that of modern humans.

This study was supported by the University of Zürich and the A.H. Schultz Foundation.

Nicotine — candy or cure? A longitudinal study of smoking vs. helminth reinfection among African hunter-gatherers.

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According to neurobiologists, the widespread use of tobacco, and the resulting global epidemic of lung cancer and heart disease, are explained by the effects of nicotine on the mesolimbic dopamine system (MDS), also known as the reward system. The MDS is believed to have evolved to reinforce behaviors leading to natural rewards such as food and sex. Nicotine increases dopaminergic transmission in the MDS, thus reinforcing tobacco consumption. Because nicotine is not thought to be responsible for cancers or other chronic tobacco-related health problems, it has been conceptualized more-or-less as 'sugar for the brain.'

Nicotine, however, evolved to defend tobacco plants from herbivores, and has a toxicity comparable to hydrogen cyanide. Moreover, in humans and laboratory animals, it activates a suite of toxin-defense mechanisms, including bitter taste receptors, nociceptive neurons, aversion, and conditioned taste avoidance, which should deter, not encourage, tobacco consumption.

Although nicotine is harmful to tobacco consumers, it is potentially even more harmful to their parasites. We report further tests of the hypothesis that the 'recreational' use of tobacco and other plant drugs is motivated, in part, by an evolved propensity to self-medicate against infections by helminths and other macroparasites. Worm burden, nicotine exposure, and control variables were measured in 68 Aka foragers from the Central African Republic. Study participants were then treated with albendazole, a commercial anthelmintic. After 12 months, worm burden and nicotine exposure were remeasured to test the hypothesis that heavier smokers would exhibit a lower rate of reinfection by helminths.

This investigation was supported in part by funds provided for medical and biological research by the State of Washington Initiative Measure No. 171.

Revisiting Pliocene hominid phylogeny: a postcranial perspective.

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Several Pliocene hominid phylogenetic hypotheses have been proposed focusing exclusively on craniodental morphology. Postcranial specimens are historically rare and are considered less informative in reconstructing the natural history of early hominids. This narrow view has resulted in our overlooking subtle, yet important evidence from the existing hominid postcranial materials. Some researchers have argued that craniodental data are inconsistent with molecular data, and hence unreliable for reconstructing phylogenetic relationships among early hominid taxa. The disparity between the two datasets is likely an indication of substantial homoplasy in craniodental features.

A recently discovered hominid partial foot from the Woranso-Mille, Central Afar, Ethiopia, clearly indicates that additional evidence from the postcranial skeleton bears directly on early hominid taxonomy, phylogenetic relationships, and locomotor adaptations. Pliocene-Pleistocene hominids are generally assumed to have been uniformly obligate terrestrial bipeds. However, preliminary analysis of the partial foot from Woranso-Mille clearly shows that there was a hominid species in the middle Pliocene of eastern Africa with a locomotor adaptation substantially different from the contemporaneous *Australopithecus afarensis*. Elements of the Woranso-Mille partial foot, which include complete first and second metatarsals, are morphologically similar to pedal elements recovered from Member 2 at Sterkfontein, South Africa. Although the phylogenetic implications of these morphological similarities, to the exclusion of *Australopithecus afarensis*, require further investigation with additional fossils, the new discoveries from Woranso-Mille indicate that earlier impressions that in eastern Africa, post-*Australopithecus anamensis* locomotor adaptations were essentially invariable need to be re-examined.

This research was supported by the National Science Foundation (BCS-0542037).

Therapeutic outcomes of medicinal plant applications in three cultural groups.

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Medicinal plant products have been successfully administered for a wide range of health problems cross-culturally since prehistoric times, and toxic side-effects have also been recorded. The safety and effectiveness of several herbal medications were evaluated with original data collected in interviews with 14 traditional healers and their patients in Caribbean and Caribbean-American populations and a survey of 92 medicinal plant shops ("botanicas") in Miami, FL.

84% of the Caribbean respondents (N=286) age 21-84 from The Bahamas and 65% of Caribbean-American subjects in Miami

(N=290) age 21-85 representing 17 Caribbean countries of origin reported regular usage of botanical medicines for disorders ranging from flatulence and dandruff to cancer and AIDS, and the medicaments were cited as particularly effective in the management of chronic conditions such as diabetes, asthma, hypertension, arthritis, insomnia, and depression. Phytochemical assays of botanical specimens obtained from the *botanicas* indicate the presence of curative bioactive pharmaceutical constituents as claimed. Preparation procedures, including boiling, dilution, the use of additives, and the combination of multiple herbs, serve to enhance phytochemical bioavailability while simultaneously reducing or neutralizing potential toxicity. In some cases the healers recommend the consumption of specific raw plant parts.

A double-blind experiment which tested the effectiveness of over-the-counter homeopathic Bach® Flower Remedies involving a sample of 111 Americans age 18-49 and weighing 87-251 pounds revealed statistically significant differences between treatment and placebo-control groups with respect to the outcomes of standardized stress tests. Gender, age, and body weight were not correlated with test results.

Linear enamel hypoplasias as stress indicators to interpret the effects of urbanization in the Iberian Peninsula.

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Linear enamel hypoplasias (LEH) have frequently been used to infer general health conditions. This study documents LEH presence to infer and compare the quality of life between temporally similar rural and urban populations from late 19th – early 20th century Portuguese. Due to the effects of urbanization an increase in LEH is expected in the urban sample.

Data was collected from the Coimbra identified collection and the new Lisbon collection. This data is compared to the Oloriz collection in Spain. Measurements of hypoplasias were taken to calculate percentage of enamel affected. Craniometric data from each population was also utilized to calculate *Fst* values to establish genetic affiliation.

Fst values suggest a close relationship with the expected variation between the Lisbon and Coimbra collections (*Fst*=0.167). However, the Lisbon and Oloriz collection exhibited the closest relationship (*Fst*=0.010) of all three samples. Paired t-tests were performed to compare the LEH frequencies and the percentage of enamel affected. The frequency comparison (*p-value* = 0.256) suggests there is no significant difference between the groups. However, the sample comparison using percentage of enamel affected (*p-value* = 0.016) indicates there is a significant difference between the two populations. These results suggest that using overall percentage enamel affected may be a more sensitive parameter than frequency alone.

The methods employed in this study as well as the use of identified collections can detect more sensitive parameters to be used in LEH studies. Also, it can contribute to our

understanding of European dynamics during this time period.

***Paralouatta*, the Cuban enigma: evidence from craniodental morphology.**

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The origin and relationships of the Caribbean primates are one of the least understood aspects of platyrrhine evolution. This project addresses the paleobiology of *Paralouatta*, a genus found in Miocene-sub-recent deposits in Cuba. Originally this taxon was assigned to the Alouattini based on cranial synapomorphies, but more primitive aspects of the skull and dentition caused some authors to place *Paralouatta* and other Caribbean platyrrhines in a sister clade to *Callicebus*. New analyses of the cranium and dentition using three-dimensional geometric morphometrics support the original interpretation, but with some further caveats.

The craniodental morphology of *Paralouatta* was compared to a large sample of extant and extinct platyrrhines. The results of a principal components analysis group the *Paralouatta* cranial base with extant *Alouatta*, as both share an airryncous face, vertically oriented occipital, and unflexed basicranium. As the cranial base is arguably the most derived portion of the *Alouatta* skeleton (due to the enlarged hyoid housed beneath it), the similarities described here between *Paralouatta* and the howler monkey strongly support their phylogenetic affinity.

Paralouatta does not, however, share dental characteristics with the crown alouattins. Overall, the fossil dentition is primitive with a lingual cingulum on the maxillary molars, a clearly delineated trigon, and basins of moderate size. In dietary reconstruction analyses, it groups with frugivorous primates, indicating that folivory may have evolved after *Paralouatta* broke with the lineage leading towards modern alouattins.

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Isotopic dietary analysis and molecular sex identification of adults and juveniles from medieval Great Moravia.

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Medieval European society, like many complex agricultural societies, was strongly patriarchal, with men favored in terms of property rights, political status, and household authority. However, it is unclear whether male dominance in medieval society was manifested in unequal access to food resources between the sexes. In this pilot study, we examine the pattern of sex-related differences in diet through biomolecular analyses of skeletal remains from the early medieval Great Moravian site of Mikulčice (Czech Republic). Mikulčice was a prominent center of Great Moravia, an early Slavic state that existed in the 9th century AD, and previous bioarchaeological studies of skeletal material from Mikulčice indicate occupational and status differences between the sexes. The pilot study sample comprises 40 individuals, including both adults (n=27) and juveniles (n=13). Here we present dietary reconstructions based on bone collagen carbon and nitrogen stable isotope analyses, and we evaluate a new method of molecular sex identification using high resolution melting analysis of ancient DNA from both juvenile and adult skeletal remains.

The middle-out approach and evolutionary inference from studies of model organisms.

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Understanding of the developmental basis for phenotypic variation is important for evolutionary explanation in several ways. Most critically, development biology offers potential insight into the evolvability of organisms in various directions of phenotype-space. The intensive study of model organisms is the only known route to unraveling the complexities of developmental systems. The difficulty, however, is that these are usually not the organisms whose evolution we are seeking to explain. Inference from model organisms to the evolutionary explanation in other groups is thus not straightforward. A key question here is choosing the level of abstraction that allows for useful application of information about model organisms to the evolution of other, related groups. Using the example of the shape of the human skull and brain-face interaction as studied in mouse and chick, we discuss the utility of inference at the gene, gene network and developmental process level. We show that useful insight can be gained when the correct level of abstraction is chosen while highly misleading inferences can be made when this is not done. We argue that the study of model organisms, which has a surprisingly rich history in biological anthropology, is a necessary adjunct to the more mainstream areas of human evolutionary studies.

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Do acoustics determine group-specific vocalizations? Effects of environmental acoustics on the infant vocalizations of two populations of *Cebus capucinus*.

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In an effort to determine what effect acoustic impedance can have on non-human primate calls, a vocal survey was performed on two groups of *Cebus capucinus* living in two acoustically different habitats, a lowland tropical rainforest and a highland tropical cloud forest. Among the calls surveyed was a specific infant-produced vocalization common among the species termed a "peep". The survey revealed the infants in the high altitude habitats were using significantly greater energy (db) on lower frequencies (Hz), causing a prosodic shift in pitch. These results are concurrent with our analysis that taken as a whole, capuchins in the high altitude cloud forest are producing lower pitch calls. The results are also concurrent with our hypothesis that capuchin calls would have to conform to exponentially higher acoustic impedance caused by a high altitude environment. Such an accommodation would include utilizing lower frequency calls which are less subject to acoustic degradation than higher frequency calls. The fact that these acoustic accommodations are detected in infant calls suggests that group-specific vocalizations arise from an accommodation to the acoustic environment and may become standardized out of this need; giving rise to group-specific vocalizations.

Precision and accuracy of acetabular size measures in fragmentary Plio-Pleistocene hominin pelvis obtained using digital sphere-fitting techniques.

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Hip joint diameter is highly correlated with body size in primates, yet our ability to infer joint size in fossil hominins is frequently impeded by the fragmentary nature of most fossil pelvis. New 3D technologies can be used to fit spheres to the lunate surface, potentially allowing hip joint diameter estimates. However, the reliability of these techniques must first be established.

Best-fit spheres were fit to the lunate surface of 3D polygonal models of extant primate (n=117) and human (n=22) pelvis in PolyWorks software. Spheres were also fit to standardized and random lunate regions. Two observers conducted multiple data-collecting trials each, with inter- and intraobserver error

<2%. These techniques were then applied to undistorted Plio-Pleistocene hominin pelvises (n=13).

The results of this study indicate that digital sphere-fitting techniques are precise (mean error $\leq 1\%$) and that the lunate does not need to be completely preserved to accurately infer hip dimensions. Joint diameter can be predicted by spheres fit to the cranial and caudal halves of the lunate, allowing for new hip joint diameter estimates to be derived for several hominins. However, we found that fitting a sphere to small portion of lunate (1 cm²) has a mean prediction error of 8% in extant primates, suggesting these techniques must be used cautiously in largely incomplete fossil acetabulae (e.g., KNM-ER 1808, TM 1605, MLD 25). These techniques provide hip joint size estimates comparable to those derived from hominin femoral head diameters and will increase our sample of fossil body size estimates.

This study was funded by NSF, the Wenner Gren Foundation, and the L.S.B. Leakey Foundation.

The role of female choice in male rank relationships and length of group membership in a captive group of rhesus macaques (*Macaca mulatta*).

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Among rhesus macaques, novel males establish their group membership and rank through a combination of social interactions with female and male residents. What is less well understood is the degree to which novel males establish their status through female grooming relationships versus male competition. We present our assessment of changes in male ranks and male survivorship in the group following the introduction of novel males into an established group of adult females in a large social group of rhesus macaques at the California National Primate Research Center (CNPRC). We evaluated the hypotheses that females prefer adult (>5 years of age) over sub-adult (4-5 years of age) males and female preference correlates with increased male rank and survivorship in the group. The diversity of female groomers was greater for novel adult compared to novel sub-adult males ($x=1.23$ groom diversity index versus $x=0.16$ groom diversity index; LR $X^2=17.85$; $df=1$; $p<0.0001$). The results of survival analysis demonstrate that adult males remained in the group longer than sub-adult males ($x=154$ days versus $x=60$ days; log-rank $X^2=10.72$; $df=1$; $p=0.0011$). Additionally, sub-adult male ranks dropped dramatically and adult male ranks increase dramatically after the all-male group was introduced to the female group. These results combined with data presented by Seil et al. (these proceedings) support female preference as a driving force in male rank relationships and longevity in social groups, while male

competition is less influential in determining male success (measured by increased rank and greater survivorship) in the group.

This project was supported by National Institutes of Health grants #R24 RR024396 and #PR51 RR000169.

Mapping the great apes: application of non-metric traits in the deciduous teeth of *Gorilla* and *Pan*.

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In studies of human populations, non-metric traits in the adult dentition are frequently used to track movement and change. This study uses previously established non-metric traits in the deciduous dentition of the great apes in order to distinguish between non-human ape populations. Twenty-eight traits in the upper and lower deciduous molars are compared according to each individual's geographic location, as well as genus, species, and sub-species. Data were collected from 284 subadult specimens of *Pan troglodytes*, *Pan paniscus*, *Gorilla gorilla gorilla*, and *Gorilla beringei graueri* from museum context. Significant differences in trait frequencies occurred in patterns roughly coinciding with the currently understood genetic relatedness of the five ape groups. Mean measure of divergence analysis of the frequency data revealed that the two *Pan troglodytes* subspecies were least divergent and that *Pan paniscus* is more similar to *P. t. schweinfurthii* than to *P. t. troglodytes*. *G. b. graueri* was most similar to the other *Gorilla* group. This study demonstrates that deciduous dental traits appear to show reliable evidence of genetic relatedness that can be further tested. Lastly, the utility of deciduous non-metric traits in distinguishing between geographically isolated ape populations is evaluated in comparison to geographic studies of permanent non-metric dental traits in humans.

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Optimizing enrichment strategies for next-generation sequencing using ancient TB.

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The characterization of strains of ancient *Mycobacterium tuberculosis*, the causative agent of tuberculosis (TB), allows us to reconstruct phylogenetic relationships critical to understanding the dynamics of TB interactions with humans prior to and after the Age of Exploration. While previous studies have successfully extracted ancient TB (Ariazza et al. 1995; Braun et al. 1998; Salo et al. 1994), the recovery of ancient pathogen DNA remains problematic due to degradation processes and contamination. Recent advancements in

enrichment strategies coupled with next-generation sequencing have been successful in isolating, amplifying and sequencing ancient DNA (e.g., Burbano et al. 2010; Maricic et al. 2010; Stiller et al. 2009). The ability to detect *M. tuberculosis* in ancient samples, to target genomic regions of interest, and to create a high quality DNA library are crucial steps in this process. Here we report on a number of analyses that: 1) Test the sensitivity of newly designed qPCR assays for detecting multi-copy insertion elements in *M. tuberculosis*, 2) Test the Direct-Multiplex Sequencing method (Stiller et al. 2009) for targeted capture of 100+ phylogenetically-informative SNPs (Hershberg et al. 2008); and, 3) Create and measure the quality of the enriched DNA libraries designed for next-generation sequencing, as well as various library purification kits. Preliminary results indicate that our IS1081 qPCR assay is sensitive in low quantity DNA, but that small multiplex PCR products are lost with SPRI purification methods during library construction. Further research will continue to optimize these steps, increasing the effectiveness of sequencing efforts.

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Murder, sacrifice, or veneration: reconstructing the identities of the victims of lethal violence interred in Room 33.

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Of the fourteen burials interred in Pueblo Bonito's Room 33 (c. 850-1150 AD), three adult males show evidence of severe perimortem cranial trauma. This research utilizes forensic and bioarchaeological techniques to identify the types of fracturing, the taphonomic context and the possible motivations behind why these males were targeted for violent deaths. Burial H/3672, aged 45-55, was associated with an excessive amount of turquoise and other exotic grave goods. He has three sharp force traumatic injuries to the cranium. This burial appears to be the first one placed in the room (690-940 cal AD) (Plog and Heitman 2010). The other two males (H/3661 and H/3668), aged 25-35, were also bludgeoned to death. They have panfacial fractures, which are fractures that involve multiple facial bones, the cranial vault, and the mandible. (He et al. 2007: 2459). According to Plog and Heitman (2010: 19623), these two males were interred much later (1023-1185 cal AD). Thus, within the larger burial assemblage recovered from Room 33, one male with cranial fractures was interred during the earliest phase of Pueblo Bonito's construction, and two males with head wounds were interred during its final periods, as the Chacoan people migrated out of the canyon. Given the context, the nature of the blows to the head, and the timing of the burials, the data suggest that these males were ritually sacrificed. The death of these individuals may have played a major role in the ceremonial and symbolic aspects of the opening and closing of Pueblo Bonito.

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The mechanical properties of maximum ingested bite size.

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Previously we found that Maximum Ingested Bite Size (Vb) – the largest piece of food that an animal will ingest whole without biting first – scales isometrically with body size for three foods and seventeen species of strepsirrhines at the Duke Lemur Center (DLC). Frugivores consistently ate larger pieces of food than did folivores. Furthermore, all species ate larger pieces of melon than the more obdurate carrot and sweet potato. If Vb can be expressed in terms of food mechanical properties then it will be possible to compare data across food types, including wild lemur foods, to better understand dietary adaptations in lemurs. To this end we quantified Vb in five species of lemurs at the DLC using ten types of food that vary widely in elasticity and toughness to determine how these properties relate to bite sizes. We found that, across all species (and for two individual species) Vb correlates significantly with food elasticity (r -square=0.49, F -Prob.<0.035); all species eat larger pieces of highly elastic (e.g., melon and pear) than less elastic (e.g., carrot) foods. There is no significant relationship between Vb and toughness in the whole sample or in any species. This suggests that elasticity may be driving bite size variation among foods and that this mechanical property should be the focus of food studies in the wild. Furthermore, these data suggest that lemurs may be judging the degree to which food can be deformed to fit into the oral cavity as they ingest pieces.

The dog days of stress: a comparison of methods for determining age at occurrence of enamel hypoplasias.

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Considering human teeth develop systematically, a chronology of an individual's childhood stressors can be determined. Studies on macroscopic methods of formulating age at disturbance suggest it is less precise than microscopic means. Nonetheless, macroscopic techniques remain the most commonly used because of the quickness and ease of calculations. The aim of this study is to compare patterns from results of macroscopic methods introduced by Goodman and colleagues (1980), Goodman and Rose (1990), Lewis and Roberts (1997), incorporating more precise data on cross-cultural timing of the completion of crown formation suggested by Reid and Dean (2006). The sample is a Colonial Maya population of 588 interments. Some 329 individuals, ranging from six to 50+ years old, were analyzed for hypoplastic defects and their associated crown locations.

Different ages of complete crown formation were substituted in the formulae, with outcomes varying greatly. Methods outlined by

Lewis and Roberts (1997) produced the youngest ages, giving a range from in-utero to 2.5 years old for incisors and from one to 2.5 years old for canines. In contrast, Goodman and Rose's (1990) technique resulted in oldest ages, with intervals for incisors from two to 3.5 years old and 2.5 to 4.9 years old for canines. Not surprisingly, Goodman and Colleagues' (1980) ages of 2.5 for incisors and 3.5 for canines are more closely related to Goodman and Rose (1990) than Lewis and Roberts (1997). Hence, selection of methodologies and age at complete crown formation need to be carefully considered when determining age of hypoplastic defects.

Taking a second look: NamUs and unidentified skeletal remains cases in Utah.

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The National Missing and Unidentified Persons System (NamUs) is a free database for missing persons and unidentified decedent records. The database compares information between the two groups for possible matches. The Utah Medical Examiner's Office (OME) is entering all unidentified modern remains found in Utah into NamUs. A total of seventeen unidentified skeletal cases are still held at the OME. Since many of these cases had questionable, little, or no anthropological analysis completed, it was decided to have a forensic anthropologist re-examine all seventeen cases to determine if the original case information was accurate before it was entered into NamUs.

The re-assessment of the cases proved interesting, as it resulted in over half being identified as archaeological or historic (>50 years). Of the seventeen cases, six were determined to be archaeological Native American, three were determined to be historic, and eight were determined to be modern and thus eligible for inclusion in NamUs. For example, one that had been ruled a modern homicide in 1982 was determined to be a historic anatomic specimen. Another that had originally been determined to be most likely archaeological Native American was determined to be a modern Hispanic. This research compares the original forensic analyses and the re-analyses with specific reference to the cases which resulted in a different temporal association or biological profile. The results of these re-analyses highlight the importance of having a competent forensic anthropologist analyze unidentified skeletal cold cases prior their inclusion in NamUs and other similar databases.

An experimentally-based interpretation of 1.5 million-year-old fossil hominin footprints: implications for the evolution of human foot function.

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Fossil hominin footprints preserve valuable information that can directly inform hypotheses regarding the evolution of human foot anatomy and gait. However, their interpretation requires an understanding of the complex interaction between foot anatomy, foot function, and soft sediment mechanics. We used an experimental approach to test the hypothesis that evidence of human foot function, specifically the distribution of plantar pressure, can be inferred from footprints. Then, we applied our experimental results to develop a comparative interpretation of *c.* 1.5 million-year-old fossil hominin footprints at Ileret, Kenya.

Thirty-eight habitually unshod and minimally shod Daasanach individuals first walked across a pressure pad, then produced footprints in sediment directly excavated from the geological layer that preserves the fossil footprints at Ileret. Water was added to this sediment such that subjects consistently produced footprints of similar overall depth to the fossil prints, thereby best approximating conditions in which the fossil prints were formed. We found significant correlations (Spearman's rank, $p < 0.0001$) between measurements of plantar pressure and relative footprint depths at ten anatomical regions across the foot. We took similar depth measurements from the Ileret fossil prints and compared them to the experimental sample. Significant differences were found between the experimental and fossil samples at multiple anatomical regions of the footprints (Mann-Whitney U, $p < 0.05$). Because sediment type and presumably sediment mechanics were constant, these differences may imply functional and/or anatomical differences between modern human feet and those of the hominins (likely *Homo erectus* or *Paranthropus boisei*) that produced the Ileret fossil footprints.

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Enteseal changes: do they reflect socioeconomic status in the Early Medieval Great Moravian population? (Mikulčice, Czech Republic, 9th – 10th century).

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Enteseal changes (EC) of skeletons of past populations are presumed to be related to the social status of individuals, characterized by grave localization/depth or grave goods. The main aim of this contribution was to verify the existence of relationships between EC distribution and archaeological data.

Fibrocartilaginous entheses of upper and lower limb bones of 115 individuals (aged 20-50 years) from the early medieval burial site Mikulčice – Kostelec were evaluated using Villotte's method (2006). The entheses were separated into four groups according to function. Factor analysis (FA) was applied three times with three different combinations of descriptors: 1) groups of entheses; 2) groups of entheses, sex and age; 3) archeological data. This third step was important for the validation of results acquired from anthropological data.

It is possible to link several models of EC distribution with certain archeological characteristics. Graves of females who demonstrate markers of stress involving upper limb flexors and lower limb entheses are superficial and contain no grave goods. Occurrence of EC in both upper limb extensors and flexors is typical for females with daily use of goods and/or jewelry. Males buried with military objects demonstrate the lowest incidence of EC, but their EC distribution is similar to that of females with jewelry.

The most important archeological descriptors related to the character of physical stress appear to be grave depth and the character of grave goods. The mere presence or absence of grave goods does not provide any important information.

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Hormonal aspects of human and chimpanzee aging.

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Even in human populations where mortality rates are high, females – if they reach adulthood – usually live well past menopause. We know that estrogen is crucial to the function of physiological systems other than fertility, yet women remain strong and healthy after ovarian estrogen secretion drops sharply with menopause. This implicates non-gonadal hormone sources in somatic maintenance. Non-ovarian steroids may also play a role in the geriatric decline observed in other primate females while they are still ovulating. What part do adrenal androgens play in the story? The adrenal steroid DHEAS has been nominated as a biomarker of primate aging based on rates of decline across adulthood that are commensurate with adult lifespan in humans and some other taxa. Patterns have yet to be characterized for our closest living relatives. Here we compare aspects of adrenal aging between humans and chimpanzees, aiming to identify mechanisms associated with slowed somatic senescence in our lineage.

We gratefully acknowledge NSF support for this research.

Dental eruption sequences in strepsirrhines.

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Dental eruption sequence (DES), or the order in which permanent teeth erupt, has been used to evaluate life history in primates. Schultz's rule posits that early molar eruption predicts a fast pace of dental and somatic development. Colobine, platyrrhine, and lemur DES have been evaluated in light of Schultz's rule with mixed results. For this study, previously unknown DESs are described for five strepsirrhine taxa. This research seeks to ultimately provide information for accurate analysis of life history in fossil primates.

Seventy five informative juveniles housed at the AMNH and NMNH were examined for crown eruption height of permanent dentition, per Harvati (2000). Molar eruption in *Galago* is relatively precocious, with M1 and M2 erupting before replacement of deciduous teeth, while M3 erupts after all replacement teeth except P3 and P4. *Otolemur* is slightly more altricial, with M2 erupting after the incisors, but before C-P4. Both *Loris* and *Perodicticus* have poorly resolved sequences, with M1 equal to the incisors and M2 and M3 generally following the incisors, canine, and P2. *Nycticebus* also has a poorly resolved sequence, but is interesting for the eruption of the permanent incisors before M1.

These findings show inconsistencies in "fast" and "slow" eruption sequences: the M2 sometimes erupts early, but the M3 erupts relatively altricially. Strepsirrhine dental eruption sequences are evaluated in relation to brain mass, body mass, dietary quality, and age at weaning. These sequences display that Schultz's rule does not easily predict dental eruption in strepsirrhines.

Assessing the pattern of Neandertal ancestry in living human populations.

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People living outside Africa today derive 2 to 4% of their ancestry from Neandertal populations. This initial estimate was based on whole-genome sequencing of a small number of individuals, and the pattern of Neandertal ancestry has yet to be characterized. Here I employ the sequencing data from the 1000 Genomes Project to identify Neandertal-derived haplotypes in living human populations. Initial sequence-level comparison allowed development of a genome-wide sample of SNP haplotypes informative of Neandertal ancestry. Humans within a population differ little in the amount of Neandertal ancestry, but the fraction does vary significantly among samples from different regions. Most Neandertal genes today are rare, existing only in one or two copies in the 1000 Genomes sample. However, a few have become majority haplotypes, 50% or higher. Europeans, South Asians, and East Asian populations differ substantially in which Neandertal-derived haplotypes are presently common, so that a haplotype present in one of these regions is very likely to be absent in samples from other regions. This heterogeneity of present-day Neandertal ancestry provides information about the Late Pleistocene dispersals of humans. In particular, today's populations outside Africa differentiated under strong genetic drift. A relatively small proportion of Neandertal-derived haplotypes

contain candidates for selection in later human populations, based on their current pattern of extended haplotype heterozygosity and fraction of derived SNP alleles. Additionally, I report on the application of these methods to investigate and visualize Neandertal ancestry at the whole-genome level from commercial SNP genotype data.

Variability in genetic ancestry in New Mexican Hispanics: the product of a rich and ever-changing ethnic landscape.

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We examined population genetic substructure among New Mexican Hispanics (NMH) to further our understanding of the admixture process and its health and social implications. Our data consisted of 251 microsatellite loci assayed in 103 NMH in the Cancer Genetics Network (NCIU24 CA78174, PI Marianne Berwick) and in 29 French and 25 Mexican Pima from the CEPH-HDGP. We used maximum likelihood methods to estimate European and Native American ancestry proportions in the NMH individuals. For each NMH, we tested three null hypotheses: 1) genetic ancestry is 100% European, 2) genetic ancestry is 0% European, and 3) genetic ancestry is 76% European (average for NMH sample). The mean European ancestry estimate of 76% is higher than that reported for any other Hispanic population in the U.S. and Mexico (published averages range from 38-63%). We rejected Hypotheses 1 and 2 for all 103 individuals. We rejected Hypothesis 3 for 20 of 103 individuals. Ten of these 20 exceeded the population average, while ten fell below the population average. This result rules out a simple, one-time admixture event in New Mexico. Six of the ten who exceeded the average reported one non-Hispanic White parent, while eight of the ten who fell below the average self-identified as 'Mexican'. These results provide a window into the types of population processes that shape human biological diversity, and they attest to the ephemeral nature of ethnic identity and the heterogeneous nature of Hispanic populations at both the between- and within-group level.

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Limb excursion patterns of an arboreal marsupial (*Petaurus breviceps*) vary with substrate size and inclination.

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Primate quadrupedalism is characterized by a variety of kinematic features not commonly observed among non-primate mammals. Convergent use of this locomotor strategy by arboreal marsupials is consistent with the hypothesis that movement within a complex arboreal milieu is the selective factor shaping primate quadrupedal kinematics. Recent studies have demonstrated that variation in substrate type and inclination influence primate kinematics, but arboreal marsupials are rarely examined with respect to these parameters, especially simultaneously. Here, we investigate the effect of substrate size and inclination on limb excursion and flexion in four adult sugar gliders (*Petaurus breviceps*), a small arboreal marsupial with grasping hands and feet. Compared to locomotion on horizontal substrates, walking up a 30° incline caused sugar gliders to reduce limb protraction angles at touchdown and increase limb retraction angles at liftoff. As substrate size decreased, sugar gliders increased knee extension, forelimb protraction and hind-limb retraction, irrespective of substrate inclination. The observed changes in limb excursion patterns in response to inclined substrates are similar to those documented for primates, despite sugar gliders' preference for lateral-sequence gaits. The combination of lateral-sequence gaits with increased forelimb protraction complicates previous associations between diagonal-sequence gaits and use of large forelimb protraction angles in primates. Finally, use of extended knee postures on the smallest substrates was unexpected, and suggests that grasping may mitigate the need to lower the body's center of mass to maintain balance.

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Proposal and validation of definitions for intact and fragmented osteons.

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Histological analysis of bone tissue has been used to explore a variety of questions relating to age-at-death, behavior, health and nutritional stress. These analyses often depend on identification of intact and fragmentary osteons, yet the working definitions of these features vary between researchers. The current definitions are often ambiguous or require subjective classifications by the observer. An exploratory study found inter-observer error and misidentification of these features to be significant. This study proposes new definitions for intact and fragmentary osteons that are designed to limit observer subjectivity and focus on the biological significance of these microanatomical structures.

A sample of 30 sixth rib cross-sections from a modern forensic population was used to test the validity of these definitions. Observations of intact osteon population density (OPD(I)) and fragmentary osteon population density (OPD(F)) were made by three observers for each cross-section. These observations were used to analyze the inter-observer error and

biological significance associated with the proposed definitions. Results indicate that the proposed definitions significantly reduce inter-observer error and misidentification of intact and fragmentary osteons; however, the inter-observer error associated with fragmentary osteons is high. The age-related biological significance observed using these definitions demonstrates that age-related accumulation of intact and fragmentary osteons is not equivalent. While the literature suggests combining OPD(I) with OPD(F) to reduce observer error, the results of this study suggest that doing so may reduce the ability to interpret bone remodeling.

Differential mortality in Albany using cemetery and skeletal data.

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As mortality rates drop in the twentieth century, there is also a growing differential in mortality rates between the sexes. These dramatic disparities do not appear to be universal prior to the twentieth century. This analysis investigates mortality in Albany, between 1671 and 2010, during which the city grew from a small rural area north of New York City into a thriving urban center, in order to determine if differences in mortality exist between the sexes during periods before the decline in death rates. The large time frame allows for the comparison of differences in mortality rates over three centuries. Two sample populations, headstone data from the Albany Rural Cemetery and skeletal records from the Albany Almshouse, are used in order to capture the diversity of the city by incorporating individuals from all social classes. The Gompertz-Makeham model of mortality is applied to compare demographic data across time and between the sexes. Results show patterns of low mortality in the twentieth century compared to data from the nineteenth and eighteenth centuries, which is consistent with increased standard of living in developed areas following the rapid industrialization and expansion of the nineteenth century. Unlike previous studies, there is no statistical difference between the eighteenth- and nineteenth-century mortality risks which suggests that either mortality rates did not increase in Albany in the nineteenth century or that mortality was always high. The only significant differences in risk of mortality between the sexes are in the twentieth century.

The Awans of northern Pakistan: emigrants from Central Asia, Arabs from western Afghanistan, or colonists from peninsular India? A dental morphometric investigation.

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The Awans are a well-known ethnic group found in the southern districts of the Khyber Pakhtunkhwa Province of Pakistan. Awans claim to be immigrants from western Afghanistan. However, Brandreth (Ibbetson 2001) asserts that Awans emigrated from north-central Afghanistan. Other researchers claim the

Awans are indigenous South Asians, being related to either Rajput or Jat populations of peninsular India (Cunningham 2010) or to local ethnic groups of the northern Indus Valley of Pakistan (Dani 1993).

This investigation is based on measurement of maximum mesiodistal lengths and buccolingual breadths of all permanent teeth, except third molars, and assessment of dental morphology variations scored in accordance with the Arizona State University Dental Morphology System in a sample of 176 Awan young adults. These data were contrasted with 21 samples of prehistoric and living individuals from Pakistan, peninsular India, Central Asia, and the Iranian Plateau. Patterns of intersample differences were examined with neighbor-joining cluster analysis and principal coordinates analysis.

Results obtained from odontometric and dental morphology analyses are highly congruent. In both cases, Awans are identified as possessing closest affinities to prehistoric inhabitants of the Indus Valley, with more distant affinities to living ethnic groups from the Hindu Kush highlands and inhabitants of peninsular India. Awans share little to no affinities to prehistoric inhabitants of Central Asia. Such results suggest that the living Awans of Mansehra District most likely represent the descendants of indigenous populations of the Indus Valley of Pakistan, and provide no support for claims of Central Asian or peninsular Indian origins.

The effect of age on enthesal changes at some fibrocartilaginous entheses.

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In 2009 during the "Workshop in musculoskeletal stress markers (MSM): limitations and achievements in the reconstruction of past activity patterns" held in Coimbra, Portugal, a working group was established to review the various methodologies used to record enthesal changes (EC); and develop a standardized system to facilitate comparisons across studies. A new qualitative method was developed by the working group for fibrocartilaginous entheses. The effects of age on the features scored using this method are presented.

The sample included male skeletons (n=31) from the identified Simon collection, Geneva, Switzerland. All individuals were manual workers (age-at-death range 23 - 73 years). Five entheses were scored on an ordinal scale for bone formation (BF) and erosion (ER) of the margin, for BF, ER, FPO (fine porosity), and MPO (macroporosity) of the enthesis surface. There is a general trend of increasing scores with age. Ordinal regression indicates that

these trends are significant for BF on the margin for the majority of entheses recorded but not significant for surface BF or FPO. The strength of the age effect varies by enthesis. ER (marginal and surface) and MPO did not display enough variation to detect age effects in many cases, but the subscapularis showed significant variation in scoring for all six categories of EC. The results indicate that age effects vary by the type of change and the muscle enthesis scored.

These results demonstrate that age effects EC, but that, using this recording method, some EC are more closely associated with age.

Age-at-death estimation in bioarchaeology: does a uniform prior perform better than an informative prior in transition analysis?

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Transition analysis offers a Bayesian statistical method for adapting skeletal aging techniques to the unique age-at-death structure of the population under study. An appropriate informative prior is always considered the best option, however, this may not be feasible with bioarchaeological samples. This context often requires the use of a uniform prior, which is usually considered undesirable. This paper compares transition analyses using a uniform prior and an informative prior on a documented historic Italian sample from Sardinia. We seek to 1) demonstrate the utility of transition analysis in bioarchaeological contexts, and 2) compare the performance of the informative prior, uniform prior, and the traditional Suchey-Brooks method.

Pubic symphyses were scored (n=390) on the Sardinian sample using the Suchey-Brooks method and subjected to transition analysis. The Terry Collection approximated a uniform prior to which a Gompertz hazard model was fit. The informative prior consisted of documented individuals from Torino, Italy. The highest posterior density regions (HPDR) were generated from the hazard model parameters and ages-at-transition. In order to test the accuracy of the uniform and informative priors, cumulative binomial tests were run on the HPDR. The results indicate the informative and uniform priors worked similarly well, both outperforming the corresponding Suchey-Brooks age ranges. These findings suggest a uniform sample may be a suitable prior when an informative prior is unavailable. A uniform prior eliminates limitations bioarchaeologists face in locating an informative prior. Adoption of the transition analysis method will strengthen age-at-death estimations and, in turn, paleodemographic investigations.

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A comparison of craniometric and molecular data from North and Central Mexico.

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Previous research has shown that craniometric data provide a proxy for molecular data (Relethford 2001; Roseman 2004) and that it is somewhat shaped by gene flow (Relethford 2004). Previous research on admixture frequencies suggests that complex population histories resulting from differential admixture account for complex biological variation found throughout Mexico (Merriwether et al. 1997, Juarez-Cedillo et al. 2008). The purpose of this study is to test whether or not craniometric data is reflective of molecular data and can be used to help interpret population history for archaeological groups representing North and Central Mexico.

Craniometric data were obtained from Sonora, Michoacán, and Tlanepantla groups, dating between AD 1200 and 1500 (Beekman and Christensen 2003) and curated at the American Museum of Natural History. Molecular data were obtained that best approximated the craniometric data population groups, including the Tarahumara, Purépecha, and the Otomi. Allele distributions from six Y-linked STRs in the Tarahumara and Purepécha populations were obtained from previously published data (Rangel-Villalobos et al. 2008). Allele distributions from the same six Y-linked STRs in the Otomi population were also studied (Barrot et al. 2007). MtDNA haplogroup frequencies from the same populations, Tarahumara, Purépecha, and Otomi, were used as well (Peñaloza-Espinosa et al. 2007). Distances matrices for the molecular data were obtained in the Kship program (Jantz, no date) and the craniometric distance matrix obtained in Rmet (Relethford 2003). A mantel test using NTSYSpc (Applied Biostatistics Inc. 1986-2000) indicates a high and significant correlation between the three types of data.

Biogeographic causes of speciation for lemurs in Madagascar.

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The mechanisms of speciation are related to the geographic distribution of populations, but the relative frequency of vicariance versus dispersal is debated. The lemurs of Madagascar are a model system to study modes of speciation because of their long isolation, geographic distributions and ecological variation. Many theories posit geographic or ecological causes for lemur species diversity and distribution, but few were generated using phylogenetic information. I tested the most likely biogeographic processes that may have led to lemur distribution and diversity. I first reconstructed the phylogeny of lemurs using a total evidence approach, combining molecular and morphological data. I used maximum parsimony and likelihood phylogenetic analyses on separate and combined datasets to build a robust phylogeny of living lemurs. I used maximum likelihood character tracing analyses to reconstruct the most likely

geographic ranges of ancestral nodes to test if vicariance or dispersal best explains divergences. The total evidence analysis yielded stronger support for most nodes than morphological or molecular data alone (>75% bootstrap support). The character tracing analysis reconstructs the nodes of family-level divergences as from the northeast of Madagascar (>90% proportional likelihoods versus other biogeographic regions). Nodes of higher-level clades, like genera, are reconstructed as from the north or northeast, while clades within genera are more widely distributed, suggesting dispersal events to other regions. The results suggest that the ancestors of most lemur taxa had their origins in the north / northeast, and subsequent speciation events were due to dispersals to other regions.

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French medieval funerary practices: quantitative and biological analysis of the skeletal remains buried in burial vaults.

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Whereas the individual burial is the rule in the Christian cemeteries around the 13th century AD, a new collective grave appears: the burial vault. In the historical and religious context of, the French Middle Ages, this research aims at determining (1) the relationship between the burial vault and the management process of corpses, and (2) the modalities and the reasons of the recruitment of the deceased in a collective burial.

In such an archaeological and historical context, a funeral (quantitative and spatial analysis) and biological (sex ratio, paleodemography) methodological approach has been developed in. Data were collected from 4 French archaeological sites (Saint-Jacques church in Troyes, Saint-Laurent Grenoble, Saint-Louis in Martigues and Observance in Aix). The data set implies 14 burial vaults, corresponding to 58 522 human remains and to 663 individuals (MNI= 663).

Results revealed various modalities of management process of corpses, from the primary burial, characterized by a election according to the age (except for children under 5 years old) and sometimes to the sex (exclusion of females?) to ossuary characterized by a significant random recruitment. The vault seems to be a social and material response of burial needs in order to perpetuate (1) the memory of an individual, family and spiritual protection, (2) the communion with the living. Furthermore, this specific collective burial type could also be an answer to the development of ecclesiastical institutions in charge of funeral industry involving the status of deceased, the spatial rationalization of the cemetery with management of human skeletal remains.

The impact of reputation on resource allocation in humans.

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In many gregarious species, including numerous primates, within-group competition for resources involves the cost physical aggression among (possibly multiple) parties; this cost can be decreased by dominance hierarchies (Maynard-Smith and Parker 1976), the orders and significance of which tend to be apparent to most group members. In this specific sense, dominance rank in nonhuman primates may be validly analogous to 'reputation' in human primates. Like their nonhuman primate relatives, humans physically contest material and social resources within groups. But humans, to a greater and likely more complex degree, must rely on their reputations to obtain contested group resources. Humans increase and defend access to group resources, including food, mates, status, medicinal substances and practices, care in times of need, etc., by increasing and defending their reputations relative to competitors, including within-group competitors. As in other species, human reputations can involve fighting ability, but human reputations are usually based on a much broader range of behaviors and capabilities such as providing benefits to others, (e.g., reproductive benefits, food resources, knowledge, contribution to group well-being, etc.).

Using experimental methods among a sample of 120 adults, we tested the impact of age, sex, reputation, physical threat, social threat, and kinship on the allocation of valuable contested resources. Results showed that resource allocation was sensitive to each of these factors in the directions predicted by theories developed in primatology and behavioral ecology.

Sex estimation from the greater sciatic notch: a morphometric approach.

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Sex estimation is a critical component in the assessment of skeletal remains from forensic and archaeological contexts. Unfortunately, methods used and widely accepted today, specifically visual assessments of the os coxae, rely on the experience of the anthropologist and the completeness of the coxal bones. Here a new quantitative method of sex estimation is proposed that requires only a partial ilium with a complete greater sciatic notch. This method was tested on a sample of 200 individuals of known sex from the Terry Collection housed at the National Museum of Natural History, Smithsonian Institution. Using a three-dimensional digitizer, three landmarks from the posterior inferior iliac spine, the ischial spine, and the deepest point of the greater sciatic notch were recorded. The distances and angles between these points were calculated, defining the width and depth of the notch. Discriminant function analyses of the linear distances and angles were used to estimate the sex of individuals of known sex with accuracy approaching 96%. Current methods rely on the presence of multiple features

of the os coxae in order to estimate sex, which can be problematic in the case of fragmentary remains. This method may permit sex estimation of fragmentary os coxae because the region containing the sciatic notch is fairly robust to taphonomic change and, therefore, tends to survive longer in archaeological and some forensic contexts.

Craniofacial phenotypic variation in craniosynostosis syndromes: the face makes the difference.

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Fibroblast growth factors and their receptors (FGF/FGFR signaling pathway) mediate proliferation, differentiation, migration, adhesion and death, of different cell types including osteogenic cells. Specific mutations of FGFR1, FGFR2 and FGFR3 have been shown to cause specific craniosynostosis syndromes (e.g., Apert, Crouzon, Pfeiffer, Muenke syndromes). Though each of these syndromes can be genetically differentiated, they share a number of phenotypic traits in common, specifically the premature fusion of one or several cranial sutures (craniosynostosis), and some overlap in variation in additional craniofacial, neural, limb, heart, lung, and/or skin anomalies. Our goal here is to determine whether the different anatomical units of the skull (base, face, vault) showed distinct morphologies characteristic of each syndrome. Morphometric analysis of 3D landmarks and semilandmarks from 3D computed tomography (CT) cranial images of patients with Apert (n=19), Crouzon (n=9), Pfeiffer (n=5) and Muenke (n=4) syndromes and those of unaffected children (n=20) revealed that facial morphology most clearly separated known diagnostic categories. When syndromic cases displaying bicoronal craniosynostosis (n=17) were compared with unaffected individuals (n=20) and with children presenting with nonsyndromic bicoronal craniosynostosis (n=14), the face was the only anatomical unit that separated the syndromic and nonsyndromic cases. These results imply that the FGFR-related causative mutation and/or the molecular pathway affected by this mutation generate additional cranial dysmorphologies characteristic of "FGFR-related craniosynostosis syndromes", particularly in the region of the face (e.g., midfacial hypoplasia, hypertelorism). Altogether, our results show that the facial phenotypes are

the only ones allowing craniosynostosis syndrome characterization.

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Allomaternal nursing among hunter-gatherers.

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Few studies exist of allomaternal nursing in humans. It is relatively common among some hunter-gatherers, such as the Aka and Efé of the Congo Basin, but it does not occur in other foragers such as the !Kung. This paper utilizes behavioral observations of Aka and Efé infants, interviews with Aka mothers with infants, ethnographic reports from researchers working with hunter-gatherers, and a survey of the eHRAF to evaluate several allomaternal nursing hypotheses from anthropology and evolutionary biology.

The study indicates that kinship, infant age, mother's condition, and culture impact the nature and frequency of allomaternal nursing. Women genetically related to the infant provided substantially more allomaternal nursing than women not genetically related to the infant; most allomaternal nursing took place in early infancy; mother's illness, difficulties in breastfeeding or personal social-economic issues were common contexts for allomaternal nursing cross-culturally; and, various aspects of culture, such as cultural ideas about women other than mother nursing children, who controls infant feeding (e.g., whether feeding is initiated by infant or mother) and residence pattern, can increase or decrease the frequency and pattern of allomaternal nursing.

Mechanical loading of the femoral neck in early hominins.

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There has been considerable debate regarding the extent to which early hominins exhibited a walking pattern similar to that of modern humans. A previous study incorporating hip and femoral dimensions of A.L. 288-1 into a biomechanical model of modern human gait predicted increased joint reaction forces and greatly increased gluteal abductor forces and M-L bending of the femoral shaft; however, this is not supported by the overall morphology of A.L. 288-1. One explanation for these findings is that early hominins exhibited increased pelvic tilt (up on the non-support side) during walking, which would have decreased abductor and joint reaction forces and reoriented the center of mass closer to the femoral head. This would also create a more vertical hip joint reaction force, increasing bending and decreasing compressive loading of the femoral neck and thereby leading to a less asymmetric (more ape-like) distribution

of cortical bone in the neck. To test this hypothesis, we measured superior and inferior cortical thickness of femoral neck bases and mid-regions of eight early South African hominins from CT scans and compared the results with reported values for modern humans and non-human primates. Superior to inferior cortex ratios for the early hominins were found to be intermediate between modern humans and non-human apes at the base and more similar to non-human apes in the mid-neck. This result is consistent with a more vertical joint reaction force acting on the femoral head and an altered gait pattern among at least some early hominins.

The mating and signaling system of the socially-tolerant crested macaque.

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The social and mating systems of primates are connected, as both derive from key elements of the environment. The macaques show great variability in both, and more socially tolerant species have more despotic mating systems, with marked sexual dimorphism and male reproductive skew. Further, mating systems determine signaling systems, with the presence of female signals of fertility such as sexual swellings dependent on factors such as mating seasonality. We tested the links between social, mating and signaling systems in the most socially-tolerant of all macaques, the crested macaque. We present data on 31 ovarian cycles from 19 females studied at Tangkoko, Sulawesi. We collected female fecal samples from which we timed ovulation, detailed observations of males and females, and calibrated images of sexual swellings. We show that female estrus periods are asynchronous, and that mating skew is marked and steep, with dominant males monopolizing a high proportion of consortships and matings. We also show that both female behavior and swelling size are reliable signals of the fertile phase, making the crested macaque very clear signalers of this compared to other tested species. We argue that this is consistent with a species where males engage in contest competition for dominance rank, in which rank is surrogate for male competitiveness, such that it is in female interest to increase paternity concentration and assurance in the most dominant males. We conclude that macaque social, mating and signaling systems are all related and describe the key ecological processes that give rise to these connections.

Long-term consequences of reduced maternal investment in rhesus macaque daughters.

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Primiparous mothers often face tradeoffs between allocating energy to reproduction and their own continued growth. Among rhesus macaques, primiparous mothers particularly restrict investment in their daughters. We investigated the long-term consequences of reduced maternal investment, using birth order as a proxy measure, among a large sample of *Macaca mulatta* females assigned to the outdoor breeding colony at the California National Primate Research Center (N=219). Although first-born daughters initiated reproduction at the same age as their later-born counterparts (first birth at 4.06±0.09 years vs. 4.04±0.05, NS), they had significantly lower body mass (6.7±0.12 kg vs. 7.1±0.09, p=0.02). Additionally, on their first parity, first-born females produced significantly less milk at peak lactation than did later-born females (10.2±1.4 grams vs. 14.1±0.9, N=56, p=0.05). These differences, however, were not present between first-born and later-born multiparous females. Both body mass (8.97±0.3 and 9.39±0.2, N=163, NS) and milk yield at peak lactation (16.76±1.2 grams vs. 16.78±0.9 grams, NS) were the same for both groups. These data demonstrate that the consequences of reduced maternal investment in infancy persist following weaning and that first-born daughters, even with ample access to food resources in captivity, can not compensate during juvenile development or at the outset of their reproductive careers. Subsequent reproductive efforts however, likely precipitate physiological processes that facilitate eventual "catch-up" during maturity. These results from a captive population suggest that under natural ecological conditions, the consequences of being a first-born daughter are of potentially greater magnitude and longer persistence.

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Postcranial morphology and the genus *Homo* hypodigm.

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In a series of influential papers, Collard and Wood have argued that two fossil hominin paleospecies, *Homo habilis* and *H. rudolfensis*, should be removed from the genus *Homo* due to their failure to meet two main criteria: 1) lack of consensus in the cladistic assignment of these two species as sister taxa to later *Homo* to the exclusion of any australopithecine species, and 2) failure of these two paleospecies to exhibit morphological characters indicative of a shared "adaptive zone" with *H. sapiens*. Here postcranial examples of these "adaptive zone" characters are re-examined in light of recent paleontological data. Specifically, relative lower

limb length, humero-femoral proportions, relative forearm length, relative pelvic breadth, and body size (as reflected in estimated body mass and a stature proxy) are examined among the australopithecines and *Homo*. It is found that only for body size is *Homo* readily distinguished from the australopithecine taxa; for all other postcranial characters there are either insufficient data or considerable morphological overlap between the australopithecines and *Homo*. These data are indicative of a pattern of mosaic postcranial evolution associated with the emergence of the genus *Homo*, and also suggest that the emergence of *H. erectus/ergaster* was not as marked a morphological shift as has been previously maintained.

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Surviving tuberculosis: healing of skeletal lesions during the recovery from active disease.

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Approximately 3-5 % of individuals with active tuberculosis develop skeletal lesions associated with the disease. The most commonly affected regions are the spine, hip and knee. Typically, anterior regions of vertebrae are destroyed and may lead to collapse of the spine. Posterior elements are usually not involved and in both spinal and non-spinal lesions, no new bone formation occurs beyond fusion of affected vertebral bodies. However, we have previously shown that elimination of the causative agent, *Mycobacterium tuberculosis* (e.g., by antibiotics), can allow extensive healing of the skeletal lesions to occur. Therefore, it is also possible that healing can occur in the pre-antibiotic time period when an individual's immune system had successfully controlled the bacteria, rendering the infection inactive. We present several pre-antibiotic cases of tuberculosis skeletal lesions from the Galler Collection (Switzerland) that have healed many years before death. All cases have medical documentation. In several cases of collapsed, kyphotic spinal columns, occurring as a result of extensive vertebral destruction, one individual displayed new bone formation on the anterior region of the twelfth thoracic and first lumbar vertebrae away from the collapsed eighth thoracic vertebra. In another case of tuberculosis that destroyed the talo-calcaneal joint, new bone formation resulted in fusion of the tibia and fibula. This information may be used in archeological contexts to show whether the tuberculosis became inactive some time before death as well as for differential diagnoses.

Language from endocasts..."If it looks like a duck..."

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Language origins remain speculative, and we will never truly know whether Neandertals, *Homo erectus*, or *Australopithecus sediba* could talk. We need a better understanding of how fMRIs light up when making stone tools, the neurological mechanisms involved in language, and the correlates of these processes with neuroanatomical structures visible on endocasts. Understanding great ape cognitive processes, particularly insight to their intrinsic symbolization processes is valuable, but not decisive. I said as much in 1969, in "Culture: A Human Domain." I argued that the cognitive processes in stone tool making and language were very similar, if not identical. Molecular genetics has already suggested that Neandertals shared the FOXP2 alleles that are found in modern *Homo sapiens*. Even if extended backward in time, these would be correlative, not truly causal. To the degree that language, handedness, and cerebral hemispheric specialization appear correlated within our own species, one can study the paleoneurological picture and look for similar, if not identical morphological characters. Modern *Homo sapiens* endocasts show definite asymmetrical Broca's areas, involved in the motor aspects of speech. The petalial pattern mostly associated with right-handedness, and thus some form of hemispheric specialization is left-occipital/parietal and right prefrontal lobe width. These same asymmetries are found in *Homo erectus/ergaster*, Asian *Homo erectus*, *Homo heidelbergensis*, and Neandertals. Add to these stone tools, true cultural traditions, and evidence of complex social cooperative behavior, and one might ask: Why not language?

Postcranial robusticity trends in Europe across the last 30,000 years.

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The postcranial skeleton of contemporary humans exhibits significantly reduced robusticity compared to Late Paleolithic ancestors. Little is known, however, of this gracilization process over the intervening period. We analyzed measures of long bone (femur, tibia, humeri) robusticity and shape for 2170 skeletons distributed broadly across Europe and ranging from 30,000 BP to 1900s. Polar modulus (Zp) and ratios of anteroposterior (AP) and mediolateral (ML) bending moments were used as estimates of diaphyseal rigidity and shape, respectively.

Lower limb robusticity decreases significantly for both sexes until around 2,000 BP, with small but significant increases in Medievals, followed by further declines into modern times. Tibia and femora become increasingly circular in cross-section until 5,000

BP, with little ulterior change. Upper limb robusticity, however, follows more complex trajectories. Male humeral robusticity fluctuates substantially, significantly decreasing between 30,000 and 2,000 BP, increasing again in Medievals, with little net change over the entire period. Females, however, show sharp robusticity declines, particularly after the Neolithic. Humeral shape for both sexes becomes increasingly more circular in post-Paleolithic groups.

The combination of reduced lower limb robusticity, albeit with some fluctuation (increases in Medievals), with increased circularity, suggests that, while physical activity levels remained high in some periods, this activity did not engender the high AP bending moments associated with elevated mobility. Similarly, the increase circularity characterizing the upper limb of post-Paleolithic groups probably reflects reduced use of technologies placing high AP bending stresses on the humerus. Results focusing on regional and finer temporal differences will also be discussed.

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Let's talk about sex: testing multiple methods for sex estimation on metacarpals and metatarsals from Um-El Jamal, Northern Jordan.

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Three methods for sex identification were tested on a sample of metacarpals and metatarsals excavated in 1996 from a commingled deposit in the Byzantine tomb, Umm El Jamal, in Northern Jordan. The purpose of the research was to test both the ease of replicability as well as accuracy among the three methods and to refine the minimum number of individual's data for the site. Methods tested included Scheuer and Elkington (1993), Case and Ross (2006), and Barrio (2006). Results showed 71% similarity across the three methods for metacarpals. Case and Ross had the easiest method to repeat, measuring only axial length on metacarpals and metatarsals, and based on that one measurement determining sex from tables previously created. Madden and Brashler's research on Umm El Jamal previously determined the minimum number of adult individuals using all skeletal elements to be 7, while this study suggests 4 based solely on the metacarpals, which fits well with previous research. The MNI based on metatarsals parallels the previous MNI of 7.

Are coastal diets healthy? Examples from the Northern Pacific Rim.

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An abundant number of studies are pointing to the colonization of the New World taking place via coastal migrations around the Pacific Rim. While many of these sites are likely submerged, others have survived and provide valuable components in reconstructing diet and health. In particular, dietary adaptations to new and changing environments and their health consequences are of interest. Specifically, is a coastal/maritime diet healthy? Maritime diets are nutrient rich but they also present challenges in the form of parasites and possible vitamin deficiencies. In the archaeological record, key rubrics of health are traditional odonto-skeletal biomarkers such as enamel hypoplasia frequencies, dental caries, dental and/or cranio-facial asymmetry, porotic hyperostosis, and cribra orbitalia: some of these markers form during growth and development and some later in adulthood. Carbon and nitrogen isotopic data aid in dietary reconstruction of proteins consumed in the last 10 to 30 years of life. Using both bioarchaeological and isotopic data, we can shed light on the effectiveness of a particular dietary adaptation on the population level. We present cross-regional and diachronic data from Japan, China, and the Pacific Northwest coast in a comparative frame to other published data from these regions (including Alaska). Hunter-gatherer bioarchaeological data represent several sites across three islands of Japan (Hokkaido, Honshu, and Kyushu) and date from the Jomon Period (4000-300 BCE) into the agricultural Yayoi period on Honshu and Kyushu and the Okhotsk Period on Hokkaido). Analysis generally suggests that coastal diets provide adequate nutrition and coastal populations are healthy.

Mantled howler monkey spatial foraging decisions: implications for cognitive evolution.

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When resources are patchy in space and time, an animal gains a selective advantage from the ability to find and relocate food items. In this way, diet may be linked to the evolution of spatial memory, with those animals with more uniform food distributions experiencing different selective pressures than those with patchier distributions. This study contributes to our knowledge of the link between diet and cognitive evolution by assessing how one of the most folivorous New World primate species—mantled howler monkeys (*Alouatta palliata*)—integrates spatial and temporal knowledge of resource distributions into foraging strategies. Specifically, the movements of mantled howler monkeys in relation to resource distributions were observed over an annual cycle (2743 observation hours) on Barro Colorado Island, Panama. Discrete choice models and agent-based simulations were then compared to observed travel patterns in order to determine whether howler monkeys maximize resources obtained per unit distance traveled or whether their behavior could be explained by less cognitively demanding foraging strategies such as movement to neighborhoods instead of individual trees, sensory travel, and movement along arboreal pathway networks without a predetermined destination. Observed travel yielded greater

quantities of resources in shorter distances traveled than all alternative strategies tested. In addition, points of significant directional change did not correlate to sites where the acquisition of new visual or auditory information was likely. Thus, this study suggests that a highly folivorous primate, hypothesized to rely on comparatively dispersed resources, integrates knowledge of spatio-temporal resource distributions in highly efficient foraging strategies.

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Sex determination using 3D coordinate landmark data of the skull: a test using a CT sample.

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Increasingly, the use of 3D coordinate data is being used for a variety of osteological analyses, including sex determination. Most studies make use of a digitizer or laser scanner to capture such data (especially for cranial landmarks), but increasingly computed tomography (CT) is being utilized as the basis for such analyses. This paper presents on the results of 3D shape analysis of cranial morphology for determining sex from human skeletal remains. 3D landmark data were collected from the orbits, mandible and skull of approximately 100 individuals from a documented age and sex CT dataset derived from post-mortem scans to investigate determination of sex. Segmentation and rendering of the CT data was done using Materialise MIMICS medical imaging software to create 3D models of the skull for each individual.

To investigate shape independent of size for each area of the skull, the coordinate data were analysed using the morphometric statistical software program PAST (PAleontological STatistics). A Procrustes fit was used to separate size and shape by scaling the raw coordinate data. Discriminant function analysis was undertaken to assess the relative accuracy of sex determination in this sample for each area of the skull from the 3D coordinate data. High levels of overall accuracy were observed (>90%) for discriminating sex from the shape data. The results are evaluated relative to other methods of sex determination in the skeleton, and the practical considerations of using a 3D coordinate approach from CT data are discussed.

The influence of lower limb length and body mass on walking kinematics at the knee and ankle.

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Previous experimentation implied that longer limbed humans moderate greater bending moments along the lower limb by keeping the knees more extended during walking, particularly during the second half of the stance phase. However, doubt was raised by others that correlations of kinetic and kinematic variables with limb length could have been confounded by covariation with body mass. In this study we aim to 1) determine which of these size variables (lower limb length, body mass) implicate kinematic moderating mechanism at the knee; 2) search for similar moderating mechanisms at the ankle.

We measured kinematics and kinetics of 22 human subjects while walking on a treadmill at their preferred speed. We analyzed associations between size variables and kinematic variables using correlation and multiple correlation analyses.

Our results suggest that: 1) it is not longer limbed individuals who keep their knees more extended during the second half of the stance phase but individuals with greater body mass; 2) individuals with longer lower limbs and greater body mass tend to keep their ankles less dorsiflexed at midstance and during the later stance phase which should reduce bending moments at the ankle and tibial midshaft through moment arm shortening. However, neither lower limb length nor body mass is significantly correlated with kinematic variables at the ankle when the other size variable is controlled for.

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Enamel thickness in *Microcebus murinus* and *Macaca mulatta* and the evolutionary genetics of enamel matrix proteins in hominoids.

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Thick molar enamel is a key feature in discussions of phylogeny, life history and dietary adaptation during human evolution. Recent genomic scans provide evidence of positive selection on the regulatory regions of many diet-related genes, including the enamel matrix proteinase *MMP20* (Haygood et al. 2007). Our long-term goal is to document links between genomic evolution and traits related to dietary changes during human evolution. One focus of this work is to sequence eight genes known to have a direct effect on enamel secretion and maturation, and to determine whether there is evidence for positive selection on the regulatory regions of these genes in hominoids. Preliminary

data on four functionally-related genes (*MMP20*, *KLK4*, *AMELX*, and *AMELY*) in *Homo*, *Pan*, *Gorilla*, *Pongo*, and *Hylobates* provide insights into the evolutionary history of major components of enamel development and structure. To expand these studies, here we report average (AET) and relative (RET) enamel thickness for the molars of *Microcebus murinus* and *Macaca mulatta*, species that serve as phylogenetic outgroups in the genomic analyses. AET and RET (Smith et al. 2003) are measured from high-resolution microCT scans using Avizo and ImageJ.

In *M. murinus*, the enamel is thin: mean AET=0.03mm, s=.007; mean RET=7.8, s=2.3 (n=3 individuals, 9 molars with moderate wear). In *M. mulatta*, the enamel is intermediate: mean AET=0.32mm, s=0.027; mean RET=14.7, s=1.6 (n=5 individuals, 7 unworn molars). These contrasting enamel thickness values provide a good basis to identify selection on genes implicated in regulating enamel formation.

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Dental morphological analysis of two Portuguese Neolithic samples.

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The development of farming is associated with profound social and biological changes globally. Such is the case on a local scale in the Iberian Peninsula during the Middle to Late Neolithic (4500-2000 BC) – a period characterized by the emergence of agriculturally dependent and complex societies. The purpose of this study is to compare dental nonmetric traits between Neolithic samples from the sites of Feteira II and Bolores, Portugal to estimate biological affinity and identify key features that contribute to variation among the interred individuals dating to this crucial time. The burial sites of Feteira II (3600-2900 BC) and Bolores (2800-1800 BC) were in use before and during a period of ecological and social change (2000/1800 B.C.). The former is a collective burial cave site with an MNI of 42 adults and 26 sub-adults. The latter is an artificial burial cave with an MNI of 14 adults and eight sub-adults. Thirty-six dental and osseous traits from the Arizona State University Dental Anthropology System were recorded in the permanent dentition with the aid of 23 reference plaques. Quantitative analyses using, among others, the Mean Measure of Divergence statistic, suggest that despite notable cultural change, there is biological continuity between the Feteira and Bolores samples. Compared to other Mediterranean area samples, Bolores, and to a lesser extent Feteira, are more similar to North African Carthaginians, Algerians, and Berbers than to southern European samples. These findings contribute to a diachronic understanding of population variation during an important time in this consequential world region.

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Congruence of brain and skull in endocast reconstruction of the infant brain.

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Endocasts provide the only means for studying brain morphology in fossil and museum specimens. However, we do not know whether endocasts reproduce brain morphology with uniform accuracy across the cranium, or whether there are regional differences in the level of detail. Further, it is also unclear whether endocasts reconstruct brain morphology in the same detail when cranial morphologies differ. Here we test two null hypotheses: 1) the space between endocranium and brain is uniformly distributed throughout the cranium, and 2) this distribution does not vary with divergent cranial morphologies.

We used 3D whole brain magnetic resonance images (MRIs) of age-matched infants between 7-80 weeks old with sagittal synostosis (N=10), right unicoronal synostosis (N=10), and infants without synostosis (N=10). We manually segmented brain and endocranial surfaces using Amira 5.2© and then collected 30 homologous landmarks from 3D surface reconstructions of brain and endocranial surfaces in *etdips*©. Linear distances between the paired homologous landmarks were calculated to determine localized measures of proximity of brain and endocranium. Volumes of endocranium, brain, and their difference were calculated. Results indicate that the volume of the space between endocranium and brain varies from 10-24% of total endocranial volume in all three groups. Further, there are significant localized differences in proximity between brain and endocranial surfaces both within and among the three groups. These results indicate that the relationship between the brain and skull is complex and varies with the shape of the skull. These findings should be considered when comparing endocranial morphologies among species.

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An examination of the agreement between genetic and dental reconstructions of biological distance among regional populations.

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This study examines the agreement among estimates of biological distance (biodistance) using microsatellite genotype and non-metric dental trait data from four coastal Kenyan populations. The major premise of biodistance analysis is that variation in visible, phenotypic traits reflects genetic variability in human populations. Therefore, the goals of the project are to determine whether non-metric dental characters and genetic data provide comparable reconstructions of biodistance and, if not, whether there are certain conditions under which these datasets can produce similar results. This study approaches these questions using genetic and dental materials from the same individuals and examines populations within a restricted regional context, which is commonly the focus of archaeological investigations.

Thirty-three non-metric dental traits were scored from dental casts and fifty microsatellite loci were genotyped from saliva samples from 350 individuals. Biodistance matrices were constructed using a variety of statistics commonly used with dental (e.g., Mean Measure of Divergence) and microsatellite (e.g., Delta Mu) data. The general expectation was that genetic and dental reconstructions would agree.

Initial reconstructions found a weak and non-significant correlation between genetic distance matrices (based on microsatellite data) and biodistance matrices (based on dental data). In general, genetic distances followed expectations based on known population history, while dental-based distances did not. Interestingly, when older statistical measures were used (Sanghvi's distance), dental-based distances improved. As such, this presentation will review the suitability of available methods, models, and statistics used to assess variation in genetic and non-metric dental characters, including the potential applications of population structure analysis.

This study was funded by the U.S. Department of Education through a Fulbright-Hays Doctoral Dissertation Research Abroad Grant (P022A090029), a Wenner-Gren Foundation Dissertation Improvement Grant (7962), and The Ohio State University Graduate School.

Diachronic cranial morphological diversity in South America: a functional approach.

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From a cranial morphological perspective, Native South Americans present high continental diversity, despite the general consensus among molecular biologists that these populations are characterized by low biological variation. Here, we test the validity of this assertion, by contrasting the between-groups morphological variation of Late South American populations with worldwide and Early South American reference groups. We focus on distinct anatomical regions from the neurocranium and the face, and test which regions are responsible for the late morphological diversity seen on the continent. Our analyses estimate minimum Fst values for different sets of populations. To

compare the results observed in South America, we calculated the Fst values for worldwide populations and for series within each continent. South American series present the highest Fst values of all continents, with values comparable to the ones observed in the worldwide analysis. This high Fst value is not observed among Early South Americans, who have very low between-group variation. When contrasted to Early Americans, each Late South American series shows high Fst values, demonstrating a strong diachronic differentiation process for the continent. The only exception to this scenario is the Botocudo Indians, who do not show high Fst values when compared to Early series and might represent a group who retained the early morphological pattern. Finally, this differentiation scenario is not uniform across all anatomical regions. Considering Botocudos, changes in the occipital and orbital regions are responsible for the morphological differences seen between them and the early series.

Bilateral positioning of nutrient foramina in the human tibia, femur, and humerus.

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Skeletal analyses sometimes rely on the position of the nutrient foramen as an anatomically stable landmark when analyzing the characteristics of fragmentary bone, yet no systematic study has tested the validity of this practice. Our aim is to test whether nutrient foramina are symmetrically positioned in paired long bones. We hypothesize that: 1) the relative position of long bone nutrient foramina with respect to overall diaphyseal length is inconsistent during ontogeny and maturity; and 2) individuals exhibit weak bilateral symmetry in nutrient foramen placement. The skeletal collection analyzed is from SunWatch Village, an Ohio Valley settlement occupied from AD 1200-1300. Individuals range from neonate to mature adult. Measurements were taken of diaphyseal length and relative nutrient foramen position in paired humeri, femora, and tibiae. Regression analyses were performed to determine whether the relative position of the foramen of the tibia, femur, and humerus remains consistent throughout development. A t-test was performed on paired long bones to assess the significance of foramen bilateral asymmetry. Regression results provide R² values of 0.17, 0.14, and 0.07 for the femur, tibia, and humerus, respectively. Thus, very little variation in foramen position is accounted for by age. T-test results indicate that bilateral differences are insignificant in all three bones. These findings support the use of nutrient foramen position as a bilaterally-symmetrical landmark; however, the degree of variation between individuals and across ages is too great to justify the use of this feature as a universal skeletal reference point.

Bilateral aging asymmetry of the auricular surface.

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Forensic anthropologists routinely estimate age-at-death of a deceased individual using the auricular surface of the os coxa. This presentation examines the dissimilarities between the left and the right auricular surfaces based on age indicator scores. It is accepted that there are occasional differences between the sides, and we hypothesize that these disparities are the exception rather than the rule. Therefore, the left and the right sides will generally be scored the same and differences, if present, will not be great.

In this study, 176 pairs of auricular surfaces from the William M. Bass Donated Collection housed at the University of Tennessee, Knoxville, were scored on 28 age indicator definitions from four different aging methods. Two additional variables were added, representing personal alternative interpretation of literature definitions. All observations were recorded by the first author.

The differences between the sides are analyzed using t-tests and simple statistical calculations, including range and percentage of dissimilarities. The results of these calculations paint a worrisome picture. While only two variables demonstrate a directional bias in age scores, 19 variables show asymmetry in greater than 30% of the cases. Indicators with a greater number of phases also have greater dissimilarities between the left and right sides.

This project illustrates that the left and right auricular surfaces are frequently at odds, and researchers should not automatically assume bilateral symmetry when aging skeletons. Anthropologists should avoid only using one side of the auricular surface unless necessary, and may need to establish new definitions of age indicators.

Cranial variation among modern Maya: assessing the effects of Spanish colonialism.

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This presentation explores cranial variation among five modern highland Guatemalan Maya populations through a lens of colonialism. After the Postclassic period collapse, the next event to have the greatest impact on Mayan biological variation was colonialism. The impact and extent of colonialism varied greatly among highland Maya populations, resulting in an array of regional exposure to its consequences—namely gene flow—with Spanish colonists. In some regions, Mayan subjugation was consistently maintained, while in other regions the Maya populations were resistant and elusive, making it difficult for colonial structure to be enforced.

It is hypothesized that the differential experiences of colonialism by Mayan populations may be exhibited via regional patterns of cranial variation. A Relethford-Blangero (1990) analysis of within-group phenotypic variance was performed to infer whether extra-regional gene flow (likely Spanish colonizers) differentially impacted the five Maya populations. The results demonstrate that only the Kaqchikel exhibit greater than expected intragroup variance (residual variance = 0.335), suggesting extra-regional populations as the

source for such variation. The remaining four groups all exhibit less than expected intragroup variation, potentially due to genetic drift. Kaqchikel exposure to colonial rule and contact was greater than other highland Maya populations, likely attributable to the overlapping location of Kaqchikel territories and the concentration of Spanish settlements. Finally, results for all samples are compared to recent research on Maya genetic variation, contributing to a better understanding of the relationship among phenotypic and genotypic interpretations of the living Maya's biohistory.

The human dental arch: fluctuating genetic influences throughout development.

TOBY E. HUGHES and GRANT C. TOWNSEND. School of Dentistry, The University of Adelaide.

Improving our understanding of factors that contribute to variation in dental arch form is important for modelling change in craniofacial structures, both developmentally, and within and between populations.

As part of a longitudinal study of dentofacial variation in a cohort of Australian twins, our aim was to apply curve-fitting methods to serial dental casts, and subsequently to estimate the contribution of the genotype to arch form at different developmental stages.

Longitudinal dental records were available for monozygotic same-sex pairs, dizygotic same-sex pairs, and opposite-sex dizygotic pairs. Standardised model photographs were obtained, landmarks digitised, and fourth-order orthogonal polynomials fitted to Cartesian data. Descriptive statistics were generated, and a series of structural equation models of individual polynomial coefficients were developed. Final models used a genetic simplex framework, allowing the contribution of genetic and environmental factors to change over time, both quantitatively (e.g., heritability) and qualitatively (e.g., different genes acting at different times).

Arches tended to be parabolic in the primary dentition, and square in the permanent dentition. Asymmetry provided a small contribution to variation at all stages of development. Genetic analyses confirmed the variable influence of a single 'core' group of genes on arch shape over time. There was also evidence of specific genes that were unique to individual developmental stages, although their relative contributions varied significantly. There was some degree of sexual heterogeneity for shape, particularly in the permanent dentition. Heritability was generally high, both for individual developmental stages, and over the course of development.

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Stature and mortality in post-medieval London.

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This study examines the relationship between stature and mortality in post-medieval London, and how that relationship may have varied with socioeconomic status. Chi-square analysis and odds ratios were used to determine if there was an association between adult tibia, femur, or tibia+femur lengths (proxies for stature) and age at death, using skeletal data from the London cemeteries of Chelsea Old Church (high status), Saint Benet Sherehog (middle status), and Lower Saint Bride's (low status).

When the three cemeteries were treated as a single sample, there were no significant relationships found between limb length and age at death. When examined separately, an association between stature and age at death emerged exclusively in males of the high status component, such that the odds of dying before age 46 were significantly higher for males of short stature than for males of average or above average stature.

There were no statistically significant results for females from any cemetery sample. The results suggest that the relationship between stature and mortality is influenced by sex and socioeconomic status. Individuals who were particularly short may have been more likely to die during childhood, except where higher social status presumably offered some degree of buffering from morbidity and mortality. Wealth may not have conferred such an advantage on females, perhaps due to preferential parental investment in sons in high status families. Investigation of juvenile mortality, and its social contexts, may further clarify these adult mortality patterns.

A comparison of heritability and evolvability estimates in a baboon sample.

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Limb length proportions (LPs) in humans and other primates are widely assumed to be highly genetically controlled traits that change only in response to long-term selection. Yet, experimental data in mammals indicate that non-genetic factors can produce substantial changes in LPs even within a single generation. This study explores this apparent contradiction through an analysis of the evolutionary potential of LPs in a single baboon sample.

Using a large pedigreed sample (n=347) of live baboons (*Papio hamadryas*) from the Primate Colony at Sukhumi (Democratic Republic of Georgia), we estimated narrow sense heritability (h^2 , or the ratio of additive genetic variance to phenotypic variance), an often used measure of evolutionary potential, and evolvability (e , or the ratio of additive genetic variation to the squared trait mean), an alternative measure with potentially greater power to detect significant evolutionary response. Our null hypothesis, based on the above-mentioned common assumption, is that LPs are highly genetically controlled and do not readily change; accordingly, LPs should show high h^2 and low e estimates. Intra- and inter-LPs calculated from limb segment data were used to estimate h^2 and e . Preliminary results indicate that h^2 estimates are moderate to high, while e

estimates are low, supporting the null hypothesis. These results are important because they show that although a trait may be highly heritable, it is not necessarily highly evolvable. Additionally, these results will significantly aid in the interpretation of the evolutionary change of LPs in humans and other primates.

Building a GIS geodatabase to aid in black howler monkey (*Alouatta pigra*) conservation management strategies.

ASHLEY L. HURST. Department of Anthropology, The University of Texas at San Antonio.

GIS geodatabases can inform primate conservation management by organizing data regarding vulnerable, endangered, and critically endangered species. One such endangered species is the black howler monkey (*Alouatta pigra*). To assess black howler monkey demographic patterns, I compiled and adjusted available data from 19 research sites throughout the species' range (Van Belle and Estrada 2006). For each site, I used ArcGIS to associate statistics for population density, group size, adult male to female ratio, and immature to adult female ratio with spatial reference points. To integrate demography with ecology, I added categorical data layers for degree of habitat protection, elevation, Normalized Difference Vegetation Index (NDVI), proximity to water resources, and proximity to roads. I placed a 5, 10, and 20 km buffer around each site reference point to assess ecological constraints. For each variable, I extracted parameters for species viability and combined them with known parameters (Luecke 2004) as a proxy to generate two best fit polygons. These polygons model the most operable corridors for *A. pigra* landscape conservation efforts without isolating breeding populations. In terms of demography, immature to adult female ratio and population density were the most important in corridor modeling. In terms of ecological variables, NDVI, elevation, and degree of formal habitat protection were the most limiting. The resulting model can be continuously adapted and expanded with the changing ecological, social, and economic data that make conservation strategies so complex. More importantly, such a model can be used as a tool to manage declining primate species worldwide.

How well does endocranial morphology predict behavioral differences in primates?

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Fossil endocranial surfaces provide the most direct evidence of brain evolution, yet they reflect only a fraction of the actual variation in brain anatomy. Ultimately, the goal is to make assessments of the behavioral implications of variation in endocranial form. Broca's cap appears to be larger on the surface of the left

endocranial hemisphere in hominins, which is suggestive of elaboration in brain function relevant to language. While brain size has been shown to be significantly associated with both group size and vocalization repertoire size in primates, direct studies of endocranial morphology and behavior has not been attempted. We used non-rigid deformation techniques to quantify localized variation in endocranial morphology across 13 primate specimens using CT scans from the Open Research Scan Archive. Behavioral data for group size and vocalization repertoire size were extracted from the literature. Correlations were calculated between behavioral variables and the degree of localized distortion required to morph each species' endocranial form into a common atlas (*Pan troglodytes*). Maps of the endocranial surface illustrating these correlations on a voxel-by-voxel basis suggest that vocal repertoire size is associated with variation in Broca's cap, superior and dorsal lateral prefrontal, orbital frontal and anterior cerebellar areas. Group size correlations were less obvious and localized in orbital frontal and the anterior temporal regions. These results suggest vocal repertoire size and group size may leave signals on the endocranial surface; furthermore, suggestive associations around Broca's cap may have implications for the relationship between non-human primate vocal behavior and language.

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Changing gender roles in prehistoric America: physical activity with the transition to agriculture in the Midwest.

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Changes in physical activity and dietary indicators are the best ways that biological anthropologists have to assess changes in agriculture. In the prehistoric Midwest, dietary indicators have demonstrated that maize consumption becomes measurable during the Late Woodland trait complex. However, it is not until the Mississippian trait complex that people become truly dependent on maize agriculture. The physical activity changes that occur during this time seem much more complex. For this study, physical activity was measured through long bone measurements and osteoarthritis classification. These data suggest that upper body activity decreased with the transition to agriculture. The analyses are consistent with previous literature, which interprets these results as indicative of better food processing techniques. Increased activity, however, was seen in the femora and may thus suggest increased weight-bearing activities with dependence on agriculture.

Additional results indicated that during the Middle and Late Woodland complexes, male and female activity patterns ran parallel. However, during the Mississippian trait complex, a significant increase in osteoarthritis scores in the weight-bearing bones of females was found while males' scores during this period decreased. This trend suggests a change in the social division of labor with the transition to agriculture that has not previously been reported.

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COMP gene related malformations of the skull: evidence from Egyptian V-VIth dynasty skeletal remains.

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Osteochondrodysplasias are a class of skeletal deformities resulting from specific genetic mutations. Abnormal COMP and FGFR3 gene expression impacts cartilage ontogeny, resulting in multiple epiphyseal dysplasia/pseudoachondroplasia and achondroplasia (respectively). Impacts of FGFR3 mutations on cranial cartilages are known, whereas there is little understanding of abnormal COMP expression in cranial development. We investigate the impact of a COMP mutation on skull development and compare it to FGFR3 changes.

Archaeologically derived individuals expressing COMP and FGFR3 characteristics (n=3) were examined. Our normal sample comprises both sexes and representatives of similar populations (n=45). We made a series of metric measurements for skull comparisons. We also evaluated the skulls against condition-specific nonmetric features compiled from the literature.

COMP individual have an enlarged cranial circumference but normal cranial length/breadth. They also have a slightly enlarged frontal breadth, possibly related to the enlarged circumference. FGFR3 expression in the cranium shows a different pattern, with increases in the cranial breadth/length but not in the circumference. FGFR3 and COMP mutations are also expressed differentially in the cranial base.

Mutations in COMP have been considered to have no or only minor impacts on skull development. Here we document cranial modifications of the nasal capsule-parachordal plate that we believe are related to mutation of the COMP gene. In later development, these basicranial changes result in a modified cranial shape that is similar to, but different from, that occurring in FGFR3 mutations. We suggest that COMP gene expression in late fetal stages may result in this unique suite of cranial modifications.

First insight into the relationship between upper-limb musculoskeletal markers, cross-sectional properties and diaphyseal contour shape.

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It is widely assumed that mechanical loads underwent by bones during life are related to muscular development, but there is a lack of quantifiable evidences in this sense. The purpose of this study is to explain how humeral diaphyseal shape is modified by muscular development. Moreover, we aim to determine what upper-limb muscles are more relevant on humeral rigidity increase and how this rigidity is related to diaphyseal shape.

The development grade of 16 upper-limb musculoskeletal markers was studied on the humeri, ulnas and radius of 30 male individuals between 30 and 45 years old from Eastern Spain archaeological sites. Three-dimensional images of the humeri were taken to digitalize the external contours of cross-sections at 35% of bone length from its distal end. Medullary canal contours were estimated from humeral biplanar radiographs. Humeral cross-sections were imported into ImageJ and analyzed using Moment Macro, and cross-sectional properties were calculated. External contours shape was inferred from a number of landmarks and semilandmarks and studied using geometric morphometrics methods.

Results based on partial least squares regressions show that humeral rigidity increase occurs when external cross-section contour at 35% of bone length tends to a circular shape. Moreover, the development of *biceps brachii* is the one with the greatest relevance on humeral rigidity increase, especially on compression and tension rigidities, whereas diaphyseal contour shape at 35% of bone length is mainly affected by *brachialis anticus* development.

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Do Kenyan grandparents invest in their grandchildren according to evolutionary predictions?

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There are various debates on grandparent investment in relationship to increased longevity and menopause. While the grandparent investment may not be the ultimate cause of such characteristics, grandparents do assist with the care of young children; this is particularly true within the context of HIV/AIDS caregiving. With the death of adult children, grandparents have a limited ability to increase their inclusive fitness other than to ensure that orphans survive

and reproduce. Thus you would expect that the level of investment will be greater in orphans than non-orphans. At the same time, level of genetic relatedness, paternity certainty and sex-specific reproductive strategies will lead differential investment based on the specific relationship of the grandparents to the grandchild. To examine these predictions, the caregiving investment of 387 Kenyan grandparents was explored using energy expenditure and caregiving intensity. Results indicate that energy expenditure was higher among caregiving women. Among grandmothers, energy expenditure increased with the number of paternal orphans in the homestead. The number of pre-teens was associated with an increase in energy expenditure, while there was no impact of teenagers or children under 5 years. In support of the Trivers-Willard effect, the number of girls in the homestead predicted energy expenditure, while there was no impact of the number of boys. This association was only present among caregivers. Results from caregiving investment were overall similar. These data suggest that grandparents invest in their grandchildren in patterns partially supportive of evolutionary predictions.

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Comparative anatomy of the lower limb muscles of hominoids: attachments, relative weights, innervation, functional morphology and evolution.

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In this presentation we report the results of an analysis of the attachments, relative weights, innervation and functional morphology of the lower limb muscles of three chimpanzees, one gorilla, two orangutans, three gibbons and various modern humans. Our dissections and literature review revealed that: 1) in modern humans and Asian apes the gluteus maximus is the largest gluteal muscle, whereas in African apes it is the gluteus medius; 2) the scansorius is larger in *Pongo* than in other hominoids; 3) the plantaris is often present in hylobatids; 4) within hominoids, an exclusive femoral origin of the popliteus is only found in gorillas and modern humans; 5) the relative weight of the deep gluteal muscles, which are mainly involved in lateral rotation of the thigh, is greater in Asian apes than in African Apes. The relative weights of the muscles involved favor flexion, abduction and medial rotation at the hip joint, plantar flexion and inversion at the ankle joint and within the foot, toe flexion. At the knee, the extensors predominate in hylobatids, the flexors in *Pongo* and *Gorilla*; in *Pan* the relative weights of the knee flexors and extensors are subequal.

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Application of human-based sensory integration therapy for improving the well-

being of a captive chimpanzee (*Pan troglodytes*).

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Holly is a young adult female chimpanzee (*Pan troglodytes*) at the Saint Louis Zoo who was identified with sensory integration and processing difficulties in 2009. At that time, she was conspicuous in range and frequency of stereotypies, restricted social interactions, lack of rest times and poor occupational performance in routine activities. Holly's abnormal behavior tended to isolate her and affected some social dynamics of the entire chimpanzee group, for example, through avoidance behavior. To improve Holly's situation, a plan providing therapeutic intervention based on human sensory integration theory was implemented. Frequencies of behavioral activity and social interactions were assessed using one-minute interval focal individual sampling to provide baseline, pre-intervention, and post-intervention data.

Prior to the application of sensory integration therapy, Holly's behavior differed from her peers and was consistent over a period of more than one year. Therapy intervention occurred over several weeks in late 2010 and early 2011, providing enhanced sensory inputs through various environmental enrichment and keeper directed activities. Following intervention, Holly demonstrated significant gains in some measures, especially in the indoor enclosure. Of particular note was a drop in stereotypies, from 21.5% to 6.5% of observed intervals. Increased positive social and occupational behaviors were also observed. Holly continued to have difficulty in the more stressful outdoor environment which provides higher levels of potentially overwhelming sensory inputs. Widespread application of occupational therapy and sensory integration theory to zoological management may be possible.

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Population continuity after all? Potential late Pleistocene dental ancestors of Holocene Nubians have been found!

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Since the mid-1960s, some anthropologists have posited biological continuity in late Pleistocene through recent Nubians. However, subsequent dental and skeletal research revealed that a broad range of Holocene samples, all of which share appreciable

spatiotemporal phenetic homogeneity, differ significantly from those at the Late Paleolithic sites of Wadi Halfa and Jebel Sahaba. If the latter two Lower Nubian samples are representative of local peoples at that time, then post-Pleistocene discontinuity is implied.

Who, then, were the ancestors of Holocene Nubians? A preliminary comparison of dental nonmetric data in 15 late Pleistocene through early historic Nubian samples (n=795 individuals) with recently discovered remains from al Khiday in Upper Nubia may provide the answer. Dating to at least 9,000+ BP, the new sample (n=40) may be the first of Late Paleolithic age recovered in >40 years; however, until additional fieldwork and dating are conducted, the excavators prefer the more conservative term of "pre-Mesolithic."

Using the Arizona State University Dental Anthropology System to record traits and multivariate statistics to estimate pairwise affinities, it is evident that al Khiday is closely akin to most Holocene samples. It is widely divergent from Jebel Sahaba. As such, there does appear to be long-term biological continuity in the region after all – though with late Pleistocene Upper- instead of Lower Nubians. While it cannot be proven that the al Khiday people were directly related, they are, minimally, indicative of what such an ancestor would be like – assuming that phenetic affinities are indicators of genetic variation.

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The "gray ceiling": why apes are not as large-brained as humans.

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To explain the evolution of human encephalization, we need to give compelling reasons why extant nonhuman apes do not have similarly large brains. Using a comparative phylogenetic approach on large datasets, we tested several hypotheses about energetic constraints on brain size evolution. We propose that early *Homo* met the increasing energetic demands of their brains through a stable increase in energy intake, both higher on average and with fewer fluctuations, and a reduction of energy expenditure through efficient bipedalism and the abandonment of climbing. We present comparative evidence that this was accomplished not through a trade-off with other expensive organs, but rather by a combined strategy of cognitive and physiological buffering against lean periods.

However, this does not explain why some other great apes could not have done the same. We argue that the limiting factor on relative brain size (the „gray ceiling“) is its tight negative relationship with life history pace, fertility, and maximum population growth rates. Any further

reduction in fertility would not allow demographically viable populations in nonhuman apes. Again utilizing comparative data, we show that the human combination of large brains and high fertility is only feasible if additional infant care is provided by non-mothers. We conclude that great ape encephalization is limited by a combination of relatively inefficient locomotion and their breeding style, as ape mothers carry the bulk of the reproductive effort alone.

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Differences between eastern and western gorillas in the forelimb and hindlimb skeletons.

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Gorilla systematics has received increased attention over the past two decades. Studies of geographic variation in DNA, skulls, and teeth have led to new taxonomic proposals, such as recognition of two species, *Gorilla gorilla* (western) and *G. beringei* (eastern), and subspecies-level recognition of Cross River gorillas (*G.g. diehli*). Using a geographically diverse sample, this study tests the hypothesis that the split between eastern and western gorillas is reflected in their forelimb and hindlimb skeletons.

Forty-three linear measurements were collected from the humerus, radius, third metacarpal, femur, tibia, calcaneus, first metatarsal, third metatarsal, and third proximal hand and foot phalanges of 266 adult gorillas. Comparisons of means and PCAs confirm clear separation between eastern and western gorillas. In particular, eastern gorillas have smaller hands and feet than western gorillas, and the eastern subspecies *G.b. beringei* and *G.b. graueri* each have smaller hands and feet than *G.g. gorilla*. Previous authors noted shorter fingers in *G.b. beringei* compared to *G.g. gorilla* and suggested this to be an adaptation to montane habitats, providing advantages for terrestrial locomotion or heat retention. Small hands and feet may reflect the evolutionary importance of montane adaptations in all eastern gorillas.

These results support the two-species proposal; however, the single available skeleton of the altitudinally-variable *G.g. diehli* with hands and feet suggests a twist. Its hand and foot bones are unusually small for *G. gorilla*. Perhaps a larger *G.g. diehli* sample would show that the lowland-dwelling *G.g. gorilla* is unique among *Gorilla* subspecies in having large hands and feet.

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The reproducibility of increased blood pressure variability during sleep in women.

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Increased ambulatory blood pressure (BP) variability has been shown to be a risk factor for cardiovascular morbidity and mortality. We have previously reported that BP is significantly more variable during sleep than during the day in women, suggesting that sleep phase transitions may induce more variability than adaptational responses during the day. Whether the nocturnal elevation is reproducible, however, is unknown. This study assessed the persistence of elevated nocturnal BP variation over two weeks in women. The subjects were 71 women (age=34.9±7.7) of varying ethnicity who each wore an ambulatory BP monitor on a midweek workday on two separate days, two weeks apart. The women all worked in clerical or technical positions at a medical center in NYC. Ambulatory BP means and variation were determined at work, (11AM-3PM), home (6PM-10PM) and overnight (approx. 10PM-6AM). These parameters were compared by day and across the settings using two-way repeated-measures ANCOVA with BMI as a covariate. The results show that BP levels and variability were consistent over the two weeks, showing similar patterns across the settings. Work systolic and diastolic BP were consistently higher than sleep (p<.001), while the proportional BP variability (coefficient of variation) (CV) was consistently lower than sleep (p<.005). Home pressure levels were also persistently higher than sleep (p<.001), while the CV of diastolic BP was lower than sleep (p<.001). These findings suggest that nocturnal BP variation is persistently greater than that during the day and that this variation may be a key contributor to cardiovascular disease risk.

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Development and annotation of molecular markers from three neotropical primate (*Platyrrhini*) species.

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The genome sequences of several primate species are available, providing insights into evolutionary and anthropological research. However, obtaining large amounts of sequence data for species whose genomes are not yet available remains time consuming and costly. Within primates genomic resources from platyrrhines are especially lacking, to date the genome of only the common marmoset, has been sequenced. This is especially limiting, considering that platyrrhines are the most speciose primate group, whose genetic diversity is comparable to that of the Catarrhini.

Here we present genomic markers developed from Spider monkey (*Ateles belzebuth*), Owl monkey (*Aotus lemurinus*), and Bald Uakari (*Cacajao calvus*) representing the three platyrrhine families, Atelidae, Cebidae, and Pitheciidae respectively. Markers were developed from gDNA shotgun libraries

containing >3,000 individual sequences with a mean length of 736 bps. Among them a large number of markers were found to have unique hits within the human (n=2,179) and the marmoset (n=2,520) genomes. Of these sequences, 970 contain <20% repeats, and are potentially highly useful markers in other platyrrhines. We determined the relative location of these markers in orthologous genomes in relation to exons, introns, and intergenic regions. > 90% of these marker sequences are located in non-coding DNA. Thus, they are likely highly useful for inferring neutral evolutionary patterns and genomic evolution in related platyrrhine species.

These annotated marker sequences are publicly available for use and will be a valuable resource for future phylogenetic and population studies as they currently provide the largest single resource of molecular data on these species.

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Cranial change in America: 1815 to 1980.

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The American population has experienced remarkable change in cranial morphology. Some of these have already been documented, but this paper expands on previous results by increasing the time frame, sample sizes and attempting to identify points in time when change begins, or proceeds most rapidly, which in turn may provide clues to reasons for the changes. Data sets employed are those from the Forensic Anthropology Data Bank, the University of Tennessee Donated collection, the Terry and Todd Anatomical collections, Civil War, and crania from historical cemeteries. All have documented birth and death dates, allowing calculation of birth year. Five standard vault and two face measurements from over 1500 crania were available. The analysis was limited to Americans of European ancestry. Size was defined as the geometric mean of the measurements, treating the vault and face measurements separately. Dividing each of the variables by size created shape variables. Cranial size shows significant increase, but the most marked change occurs in shape. Cranial vaults become higher (basion-bregma), bases become longer (basion-nasion), and bases become narrower (biauricular breadth). Most changes begin occurring mid to late 19th century and continue through the 1980s. There is negative interaction in the shape variables of breadth and those of height and base length. Face changes are less pronounced, but faces become significantly narrower and higher. An explanation of why these changes take place cannot yet be offered, but their timing offers a place to begin the search for correspondence with changes in quality of life.

Associations between skeletal fractures and locomotor behavior, habitat use, and body mass in nonhuman primates.

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Falling injuries may be the most common cause of long bone trauma among nonhuman primates, yet the interrelatedness of trauma and positional behavior is poorly understood. In this study, 300 fractures affecting long bones from 1672 primates encompassing 22 taxonomic groups were examined macroscopically and radiographically. Among a spectrum of behaviors, larger, more arboreal primates commonly active higher in the canopy and/or primarily engaging in specialized locomotor modes all should exhibit increased fracture frequencies due to their greater risk of falling, or falling with more severe repercussions.

Fracture frequencies are highly correlated with locomotor mode. As expected, suspensory primates exhibit the highest fracture frequencies; however, leapers exhibit the lowest. Results of multivariate statistical analyses suggest that fracture patterns are most closely associated with locomotor mode and body mass, followed by arboreality and vertical distribution. When suspensory primates break a bone, it tends to be the humerus or femur. Smaller arboreal quadrupeds are more likely to fracture their tibia or fibula than another bone, whereas larger quadrupeds tend to fracture any long bone preferentially except for the tibia or fibula. Fracture occurrences in leaping primates tend either to involve the clavicle preferentially or are independent of location.

Associations revealed in this study appear to highlight the importance of risk avoidance in primate evolution. Skeletal trauma may affect reproductive fitness directly or incidentally. Consequently, primates should be under selective pressure to avoid the risk of obtaining fractures, developing behavioral and anatomical mechanisms to reduce the number and severity of falls from heights.

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Women living with parents-in-law are more fertile.

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In human families, the expected levels of involvement in child care differ for paternal and maternal grandparents (mostly due to paternity uncertainty). We tested how living with paternal versus maternal grandparents (or living without any grandparents) influenced fertility parameters of families and the biological condition of children. 592 families having in total 2264 children from the Mogielica Human Ecology Study Site in rural Poland took part in the study. Women (at least 45 years of age) who during their reproductive years lived with parents-in-law were found to have significantly more children (average 5.8 children per woman) than women

who lived with their own parents (average 3.9). Higher fertility of women who lived with their in-laws was achieved through extending their reproductive lifespans: they gave birth to their last child, on average, at the age of 36.7, which is 4.5 years later than did women who lived with their own parents (32.3 years). Average age of first reproduction was the same in both groups (23.5 years). Average weight and length of children at birth did not vary significantly among groups. One may speculate that paternal grandparents, who, because of paternity uncertainty, have a lower expected relatedness to each of their son's children, maximize their inclusive fitness when the number of their grandchildren is higher. In contrast, the maternal grandparents benefit more by promoting the biological quality of their daughter's children, rather than their numbers. The psychological and biological mechanisms through which such effects are achieved are under study.

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The spatial distribution of skeletal stress indicators in a 4th century Romano-British sample: a study using ArcGIS.

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The Butt Road cemetery from Colchester England is a large Roman cemetery primarily in use during the 4th century AD. A stratified random sample of 153 individuals from Period 2 of the cemetery is used to investigate the spatial distribution of skeletal stress indicators including linear enamel hypoplasias, cribra orbitalia, maxillary sinusitis, and periostitis of the tibia within the cemetery. The mortuary treatment of individuals within this cemetery is very uniform. All 4th century AD graves were oriented east-west and grave goods were rarely included in these burials. The uniformity in burial treatment suggests that these individuals shared the same group identity and may have shared the same general socioeconomic background.

ArcGIS is used to map the distribution of each variable within the cemetery. The cemetery is analyzed using visual inspection, high/low (Gettis order) cluster analysis, and chi-square. Visual inspection of the cemetery suggests that subadults may be buried in groups rather than being evenly distributed among adult males and females. There does not appear to be a preference for location of adult male or adult female burials. High/low cluster analysis results indicate that age, sex, and skeletal stress distributions are fairly random in spatial distribution. The lack of significant clustering of skeletal stress indicators suggests that the burial sample was drawn from individuals living in and around Roman Colchester with the same group identity and a similar socioeconomic background.

Craneometric morphological patterns in hominin evolution.

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Here we analyze craniometric variability in a large sample of anatomically modern humans, big apes and extinct hominins in the search for overall craniometric patterns in both australopithecids and extinct *Homo*. Specifically, we have used six metric variables, three for the neurocranium and three for the splanchnocranium. The results obtained in a principal components analysis allow characterizing the morphospace of the living hominoids and the extinct hominins using the first two components (93% of the original variance accounted for).

According to the scores of the cranial specimens on the bivariate plot for these components, we interpret the first one as a shape vector. In this component, the individuals follow a morphological gradient wherein those individuals with larger faces and smaller neurocrania score on the left side, while those with smaller faces and larger neurocrania are placed on the right side. The second component can be interpreted as a size vector. As a result we can infer three different general patterns. The big apes and australopithecids share a similar morphological trend: the smaller the cranium is, more human-like it resembles. Thus, their shape differences are only a matter of size. However, a dramatic change arises with extinct *Homo*, because the bigger the cranium is, more human-like it resembles. The last trend, which is the opposite to that shown by the big apes and australopithecids, leads to the pattern of modern humans, in which the neurocranium is larger and the face is smaller than in a similar sized extinct *Homo*.

Ligers and tigons and pizzlies, oh my!: the morphological consequences of intergenetic hybridization in the cranium of a rheboon (*Macaca mulatta* x *Papio hamadryas*).

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The morphology of first generation intergenetic hybrids can be compared to that of the parental genera to provide information on the extent and nature of genetic differences in morphology between genera. If these differences are due to simple additive effects of genes, hybrid mean phenotypes should fall midway between the two parental genera means. However, interactions among alleles within (dominance) or between (epistasis) loci can cause hybrid mean phenotypes to deviate from this pattern. Examining intergenetic hybrids can

relay information about the effects of genes contributing to species maintenance, particularly within a primate group (papionins) that has historically practiced much hybridization among its constituent members.

Here, we measure craniofacial variation in a group of male baboons (*Papio hamadryas*) from the Southwest National Primate Research Center in San Antonio, TX (N=194) and a group of male macaques (*Macaca mulatta*) from Cayo Santiago Island, Puerto Rico (N=81) using 13 Euclidean interlandmark distances. A single male "rheboon" represents the F1 intergenetic hybrids. A discriminant function analysis correctly classifies 274 (99.6%) of the individuals into their groups. The rheboon falls roughly half-way between the two genera along the first discriminant function axis (posterior probabilities of group membership according to Mahalanobis distances: for baboons $P = 0.01$, for macaques $P = 0.06$). These results are surprising given that the disruption of gene complexes differentially co-adapted in the two genera is expected to cause dysgenesis, or a hybrid mean phenotype that is significantly lower than the midway mean value.

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Red is not a proxy signal for human female genitalia.

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Red is a colour that induces physiological and psychological effects in humans, affecting competitive and sporting success, signaling and enhancing male social dominance. The colour is also associated with increased sexual attractiveness, such that women associated with red objects or contexts are regarded as more desirable. It has been proposed that human males have a biological predisposition towards the colour red such that it is 'sexually salient'. This hypothesis argues that women use the colour red to announce impending ovulation and sexual proceptivity, with these functioning as proxy signals for genital colour, and that men show increased attraction in consequence. In the first test of this hypothesis, we show that contrary to the hypothesis, heterosexual men did not prefer redder (naturalistically coloured) female genitalia and, by extension, that red is not a proxy signal for genital colour. We found preference for pinker shades with images of red genitalia rated significantly less sexually attractive. This effect was independent of variation in female genital morphology, and prior sexual experience. Our results refute the hypothesis that men's attraction to red is linked to an implied relationship to genital colour and women's signaling of fertility and sexual proceptivity.

Nutritional composition of foods eaten by chacma baboons in the Tokai Forest of the Cape Peninsula, South Africa.

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Knowledge of nutritional aspects of primate diets is important because adequate nutrition is critical for successful reproduction. This is especially relevant in changing environments, where dietary requirements contribute to wildlife management decisions. We present data on the nutritional content of foods eaten by chacma baboons (*Papio ursinus*) in the Tokai Forest from all day follows (n=30) between July 2010-August 2010. Our goal was to quantify the amount of fiber, protein, fat, and non-structural carbohydrates in foods eaten by Tokai baboons. We recorded foods eaten and collected representative samples for nutritional analysis. We analyzed the nutrient content of 69 samples representing 29 plant species. Overall, foods contained 9-70% neutral detergent fiber (NDF), 8-50% acid detergent fiber (ADF), 1-28% acid detergent lignin (ADL), 2-28% crude protein (CP), 1≤12% fat, and 1-62% total nonstructural carbohydrates (TNC). On average, roots eaten were lower in hemicellulose and CP than other plant parts, and contained the most TNC. Mushrooms contained the least cellulose, lignin and TNC, but highest CP content. Fruits contained the most fat and lignin. This is the first detailed study of the dietary composition and nutritional content of foods eaten by chacma baboons in the Cape Peninsula of South Africa. This new information allows for comparative nutritional study of baboons across habitat types, provides insight into chacma baboon feeding ecology, and allows for better informed management decisions.

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A case of nasal teeth from the Middle Horizon Tiwanaku site of Chen Chen M1 in the Moquegua Valley, Peru.

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Ectopic eruption of teeth can occur in various parts of the body including the nasal cavity. Nasal teeth are rare in clinical settings and are reported less frequently for human skeletal remains from archaeological contexts. Ectopic teeth presenting in the nasal cavity can be permanent, deciduous, or supernumerary. In clinical settings nasal teeth are associated with increased morbidity and symptoms including posterior nasal dripping, mild facial pain, headache, and fever. This poster presents one of the few cases of nasal teeth documented in archaeological human remains in a specimen from the Middle Horizon (AD 500-1000)

Tiwanaku site of Chen Chen M1, located in the Moquegua Valley of southwestern Peru.

Specimen M1-0267 exhibited bilateral elevated concrescences on the floor of the nasal cavity. After removal of residual matrix covering the area, enamel was visible indicating the presence of partially erupted nasal teeth. Radiographs were obtained to aid identification of the tooth type(s). No clear osteological evidence of associated symptoms was detected, however much of the anterior maxillary dentition was lost antemortem. Dental and skeletal indicators of sex and age at death suggest the individual was male and survived to middle adulthood. This may indicate the nasal teeth were asymptomatic during life or that any associated symptoms did not affect the skeletal or dental hard tissues. This study demonstrates the importance of thorough curation and examination of archaeological human skeletal remains for detecting rare morphological variations of clinical, biological, and anthropological interest.

Quantitative genetic analysis reveals trade-offs between age at first reproduction and fertility.

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The quantitative genetic theory of life histories predicts negative additive genetic covariances between life-history characters, indicating trade-offs and intermediate optima. Despite these expectations, negative covariances are difficult to measure in practice because of data with incomplete pedigrees or large environmental variance. I test the hypothesis that life-history traits in a frontier population show significant heritabilities and that these traits are constrained by the additive genetic covariance structure. Demographic data with full genealogical information were drawn from the Utah Population Database. I use four traits: (1) age at first reproduction (AFR), (2) average interbirth interval (IBI), (3) reproductive span, and (4) fraction of births surviving to their 15th birthday (recruitment). Quantitative genetic parameters were estimated from an animal model fit to multiple genealogical samples using MCMC simulation of the joint posterior distribution.

All four traits show significant heritabilities, ranging from 0.21 to 0.56, indicating a substantial contribution to the phenotypic values by additive genetic variation. Significant negative covariances were found between AFR and average IBI and AFR and reproductive span. Early reproduction, while favored in a growing population, trades off against lower fertility overall because of longer birth intervals. I construct a demographic model to calculate the selection gradient on these life history traits. The predicted net response to selection yields a reduction in IBI, lower recruitment success, and later AFR despite the selection gradient pushing in the opposite direction for the latter two traits.

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Monkeys on the menu? Reconciling patterns of primate hunting and consumption in a central African Village.

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Increased hunting in response to rural population increases, changing technology and growing market economies have led to marked declines in primate populations. Yet, primate abundance intersects with cultural preferences and market values to influence what appears in markets and in cooking pots. This study employs market data (n = 157 days), hunter preference surveys (n = 290) and semi-structured interviews with market women (n = 10) and hunters (n = 113) in the town of Bayanga, Central African Republic (2008-2009) to address relationships between market availability, primate abundance and hunter catchments. Market data show a 102% increase in the presence of primate species for sale and a shift in overall prey profiles since 2006 ($\chi^2 = 19.5$, $p = 0.0001$). However, comparative hunter catchment data indicate that the proportions of primate species hunted have not increased significantly, even though the numbers of individuals captured have increased 10 fold since 1994 (2009 = 10,473 primates/year). The increase in primates captured corresponds with transect data demonstrating declining primate abundance (encounters/km) over time (2002-2009, $U = 71.5$, $p < 0.004$). While increases in the proportions of primates at market stem from declining ungulate populations and increasing use of firearms, our data suggest that cultural values, taste preference and overall market worth also factor into hunter and consumer practices. Contextualizing the consumptive use of primates within larger ecological, market and ethnographic datasets allows us reconcile incongruous patterns surrounding the demand for nonhuman primate meat and maximize conservation efforts in central African villages.

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Vertebral cross-sectional properties: temporal trends and influence of physical activity.

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Clinical studies suggest that the spinal column and vertebrae respond to biomechanical loadings in a similar manner as other weight-bearing elements. Vertebral size and strength are

strongly correlated and spinal fractures are clearly associated with reduced vertebral size. In this study we investigated temporal differences in vertebral size parameters and the role of physical activity on them. We utilized three medieval archaeological samples from the UK (Blackgate and York) and Sweden (Westerhus), and a late prehistoric SW Amerindian sample (Puye). Terry and Bass skeletal collections were employed as modern day reference samples. In addition, a lumbar spine MRI clinical cohort (NFBC 1986) was utilized in a further attempt to clarify the role of physical activity on vertebral size. To estimate vertebral size we measured six height, width and length dimensions of the corpus of the 4th lumbar vertebra in both skeletal and MRI samples. Activity levels were assessed in two ways. For the skeletal samples, we determined midshaft femoral strength using pQCT scans or biplanar x-rays combined with external molding; increased femoral strength relative to body size was considered evidence of increased activity level. For the clinical MRI sample the activity information was based on answers to a questionnaire about individuals' physical activities. Our results indicate that relative vertebral size has decreased temporally along with general "gracilization" of the skeleton. However, clear and unquestionable association between physical activity and relative vertebral size was not found; thus, further studies are needed to explain the observed temporal variation in vertebral properties.

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Maternal genetic structure of the Poqomchi' Maya of eastern Guatemala.

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Poqomchi' Maya is spoken in the eastern Guatemalan highlands and western El Salvador. This population is of special interest because of their relative isolation from Europeans and non-Mayan populations. This project characterizes the genetic structure of the Poqomchi' using mtDNA haplogroup and sequence variation and compares the results to published data on surrounding Maya and non-Mayan Indians. These data are used to make inferences into the legitimacy of treating Maya as a homogenous population distinct from other major language and ethnic groups. Blood samples were collected from two Poqomchi' aldeas in Alta Vera Paz, Guatemala. A 446 bp fragment of HVSI was sequenced and haplogroup assignment confirmed on a subset of the samples using SBE multiplex assay. The sample exhibits 100% Native American mtDNA haplogroups representing three of the five common in the Americas (A=81.5%, B=9.25%, C=9.25%). The Poqomchi' exhibit moderate levels of diversity ($h=0.94710$ and $\pi=0.01469$). This diversity has accumulated during a recent population expansion as evidenced by significantly negative Tajima's D and Fu's F_s scores (-1.51109, -21.84239) and an accumulation of low frequency mutations. MJ network analysis, mismatch analysis, and MDS plots were performed. The

population exhibits a genetic similarity to other Maya and Mexican populations; however some substructure is present due to the absence of non-Native admixture and haplogroup D. These findings are consistent with previous studies in Central America and Mesoamerica. Despite a long history of European colonization, the sample exhibits 100% Native American mtDNA haplogroups owing to their isolation within the Guatemalan highlands.

This research was funded by a General Research Fund grant from the University of Kansas and the Tinker Foundation Summer Field Research Grant.

Unlocking the past: bioarchaeology and the history of Denver's Cheesman Park.

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In 2010 and 2011, construction activities in Denver's Cheesman Park unearthed human remains, all of which were archaeological in context. Between 1860 and 1897, the land was known as Mt. Prospect Cemetery, and a reported 2000-4000 individuals were buried there. Because there were rumors the cemetery had been built upon a Native American burial ground, the Denver Office of the Medical Examiner requested that the Metropolitan State College of Denver Human Identification Laboratory, directed by Dr. Catherine Gaither, complete an osteological analysis to attempt a determination of ancestry. Analysis revealed there were no Native American remains; however, there were a number of interesting finds that supported what was known historically about the period. One set of remains, case number MSCD-HIL-11-03-03, presented with evidence of tuberculosis. Specifically, periostitis on the pulmonary surface of several ribs was recorded. This is significant because a sanatorium for patients with tuberculosis was located in Denver, and it is reasonable to presume that some patients may have been buried in the potter's field of the Mt. Prospect Cemetery. This study presents the results of the bioarchaeological and historical analyses completed on this case, and these results are discussed within the context of the history of the site. Additionally, the research shows how interagency cooperation and multidisciplinary methods can be effective tools in the urban setting, and can provide students with the opportunity to gain valuable practical experience.

Concurrent isolation and amplification of primate genomes, transcriptomes, and microbiomes from small tissue (hair) samples.

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Recent advances in high-throughput DNA sequencing and bioinformatics are opening

new avenues of research in primatology. This includes population-level genome sequencing (population genomics) and gene expression profiling (comparative transcriptomics). In addition to DNA sequences representing the genome and RNA sequences representing the transcriptome, biological samples also contain sequences representing the bacterial community of the sample; this microbiome can also be characterized and studied using a meta-genomic sequencing approach. Although methods for sequencing are advancing rapidly, obtaining adequate sample material remains a limiting factor for many studies, especially those focused on wild primate populations. A possible means to overcome the limits of small samples would be to amplify the starting material (DNA and RNA) prior to sequencing. We evaluated the potential for this approach by testing several commercial reagents and protocols for whole genome amplification (WGA) and whole transcriptome amplification (WTA) using DNA and RNA from plucked primate hair follicles. Hair samples were collected from three primate species: *Homo sapiens*, *Symphalangus syndactylus*, *Eulemur mongoz*. Using matched samples, we independently tested two WGA protocols (Qiagen, Illustra) and two WTA protocols (Qiagen, Sigma-Aldrich). PCR and qPCR results for primate nuclear DNA and RNA (*ACTB*, *MITF*) and microbial DNA (*16S rRNA*) were compared between original DNA and RNA products and those of the WGA and WTA kits, respectively. Results indicate that both WGA protocols generally worked well for primate and microbial DNA. Gene expression comparisons using qPCR, however, indicate that one protocol (Sigma-Aldrich) yielded more consistent results when comparing original RNA and WTA amplicons.

Influence of association with red colobus (*Procolobus badius*) on the feeding ecology of Diana monkeys (*Cercopithecus diana*) in the Ivory Coast's Taï Forest.

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Mixed-species associations are common in several primate radiations including cercopithecids. Participation in such associations provides important benefits such as increased predator protection, but may also involve significant costs including decreased foraging efficiency. Such costs are unlikely to be equally distributed among participating species and should vary with the tendency for a species to initiate and maintain an association.

In the Ivory Coast's Taï Forest, *Cercopithecus diana* is the central species in a community of cercopithecids that regularly forms polyspecific associations. Red colobus (*Procolobus badius*) at Taï are attracted to diana monkey groups and both experimental and long term data have shown that the diana monkey-red colobus association provides mutual benefits for both taxa. Associations mitigate predation pressure on *P. badius* from ground predators, especially chimpanzees, while *C. diana* is hypothesized to experience reduced predation pressure from raptors. Although prior work

demonstrated that diet overlap is not a significant cost to either species, it is not yet known if Diana monkey feeding ecology is affected by the presence of red colobus. Here, we examine the influence of association on Diana feeding ecology using five years of data on three groups testing a null hypothesis of no difference.

Diana monkeys associated with red colobus during 63% of observations. In association, fruit intake was higher (69.5% vs. 64%) while insect (26% vs. 29%) and leaf (4% vs. 6%) consumption decreased. We reject the null hypothesis and conclude that the Diana monkey diet improves with association.

Executions at the Hamam? Forensic investigations in a shaft well from Medieval Ayasuluk (Turkey).

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Human and nonhuman skeletal remains recovered from a shaft well (1.25 x 1.25 m) of a 15th century Hamam (public steam bath) in Ayasuluk/Ephesus were investigated using osteopathology, forensic anthropology, and historic veterinary techniques to clarify circumstances of death and postmortem treatment.

Two males, aged 22 and 36, were identified. The older man was missing his 5th cervical vertebra and the entire cranium, except for fragments of his frontal and parietals. These pieces showed signs of external burning, as did the elbow joints, and were accompanied by signs of peeling. Osteopathological analysis of the younger male revealed an intravital fracture on the right arch of the 5th lumbar vertebra and significant laterality of his glenoid cavity, often observed in swordsmen or archers. Analysis of the animal remains revealed two skeletons in toto, a noble horse, including four iron horseshoes, and a well cared-for dog.

Taphonomic reconstruction revealed all individuals were buried during the same, desecrating event. Reported violent riots at this time and the lack of personal effects such as belts buckles, buttons or similar objects point to politically motivated executions because objects became the property of the executioner.

All of the reported execution methods could be excluded except for strangulation for the younger individual and for hanging, strangulation and decapitation for the older one because of the missing of the 5th cervical vertebra. The signs of bodily mutilation seem to be the result of him being dragged and then his head and elbow being placed in an open fire.

eFossils.org: a collaborative website and community database for the study of human evolution.

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The fossil evidence for human evolution has expanded dramatically over the past 30 years and the rapid growth of this record has challenged the traditional approaches of a classroom lecture and hands-on laboratory. In order to provide current information to students, we have built a robust collaborative website, eFossils.org. This website incorporates various data from human evolution (e.g., anatomy, geology, geography, geochronology) within a multimedia learning environment (e.g., color images, 3D animations, video) and offers a series of online tools to visually represent these data and permit their study. The eFossils catalog uses the Darwin Core schema and permits the display and mapping of data sets from any project. The website also includes a "collaboratorium," a web tool built on a generic template that permits the research community to collaborate on large-scale problems. Collecting all the information for human evolution into a single database is now too large an undertaking for any one group; instead, eFossils is constructed for the collaborative participation of subject-matter experts. We have populated eFossils with several site reports about key hominin fossil localities in order to seed the process of providing a data-rich online presentation. Additional localities can be populated through a collaborative expansion of the database by registered users. Consequently, the organic nature of eFossils reflects the dynamic nature of the field, and as users expand the database with their own research, the "ownership" of the site will transfer to the user community in a manner that mirrors the online expert wikis.

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Occlusal microwear texture analysis of Croatian Neandertals.

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Aspects of Neandertal diet have been examined using a variety of techniques. Recently, dental microwear texture analysis has been used to make inferences about diet in Neandertals. Previous research by el Zaatari found that there was ecogeographic variation in Neandertal diet, with texture values being higher for Neandertals living in woodland areas than for those living in dryer steppe regions. We examined 24 molars (preferably the lower M2) from Krapina (n=20) and Vindija (n=4) using white light confocal microscopy. Three variables

were assessed using Toothfrax and Sfrax software to describe molar occlusal surfaces via scale-sensitive fractal geometry. The variables used were complexity (Asfc), anisotropy (epLsar), and textural fill volume (tfv). We hypothesized that the molars from Krapina and Vindija would have higher texture values than those reported for Neandertals from more open environments. Our results indicate that Vindija had complexity and anisotropy values (0.84 and 0.0027, respectively) that are comparable to woodland Neandertals and Pre-Neandertals. Likewise, Krapina had complexity that is similar to woodland Neandertals (1.11), but its anisotropy is far higher (0.0042), indicating a more fibrous diet. Tfv was higher for Vindija (46,367) than Krapina (35,518) indicating that its diet was harder. Dates for Krapina place it at approximately 130,000 years ago, which is far older than Vindija (about 42,000 years ago for level G3). The higher anisotropy at Krapina might relate to its earlier age, slight ecological differences, or depositional environment.

Correlations between nitrogen isotope levels and stature in three Northern California prehistoric groups.

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This study examines the correlations between dietary isotope levels and adult human stature. Physical anthropologists have long recognized the association of health status and nutrition with stature. Bioarchaeological studies of health and nutrition in prehistoric groups attribute temporal variation in stature to changing subsistence strategies over time, with the animal protein content of diet considered positively correlated with among-group variation in stature. Further, within-group differences in protein intake have been found to be positively correlated with nitrogen isotope values ($\delta^{15}\text{N}$) in modern human groups. These positive correlations, one between stature and dietary protein, and the other between dietary protein and ^{15}N levels, imply that may ^{15}N may be a useful predictor of stature.

This study tests the hypothesis that within-group variation in ^{15}N levels and stature are positively correlated in prehistoric California groups. Skeletal remains from Marsh Creek (CCO-548), Pleasanton (ALA-554), and Ryan Mound (ALA-329) were studied, providing data for groups with an intensive marine resource subsistence strategy and an intensive aco-processing subsistence strategy. Based on preliminary analysis of the Marsh Creek sample, a linear model of stature regressed on both sex (a consistently useful within-group predictor of stature) and ^{15}N levels (AIC = 344; adjusted $R^2 = 0.51$) outperforms the model in which stature is predicted based on sex alone (AIC = 349; adjusted $R^2 = 0.45$). These results suggest further potential utility to integrating dietary isotope and morphological data in bioarchaeology.

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Fellowship from the University of California, Davis department of Anthropology.

Identification of historic individuals: the unknown sailor from the HMAS Sydney II.

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The ability of physical anthropologists to identify historic individuals through a range of analytical techniques has assisted investigations and engaged the public in our discipline. Stable isotope analysis of a range of elements along with osteological, dental, historical and DNA evidence have all been carried out in an attempt to identify an unknown sailor from the 1940s. On November 19, 1941, the naval vessel, HMAS Sydney II sank off the western coast of Australia following a battle with a German ship. The loss of all 645 crew members of the HMAS Sydney II was the largest single naval loss in Australian military history. In February of 1942, an unidentified dead sailor was recovered from a life raft near Christmas Island, where he was buried following a post mortem examination. As the only potential link with the HMAS Sydney II, there has been tremendous public interest in the identification of this individual, who was exhumed in 2006. Osteological analysis indicates that the individual was a young male of European ancestry who suffered a shrapnel wound to the head. Isotopic analyses were carried out on a rib fragment and one tooth. Results for carbon, nitrogen, sulfur and strontium isotopes are consistent in identifying a diet very high in marine foods and oxygen isotopes indicate a place of residence in the tropics. These analyses highlight both the potential and the limitations of the various analytical methods employed. While the exact identification remains uncertain, the range of possibilities has been reduced considerably.

This research was supported by the Royal Australian Navy.

Unexpected regional differences in collagen fiber orientation heterogeneity (CFO-Het) between chimpanzee and human proximal femoral shafts: is CFO-Het still a useful characteristic for corroborating load history data?

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Gray levels (GLs) in circularly polarized light (CPL) images reflect predominant collagen fiber orientation (CFO) (Skedros et al. 2011 J. Anatomy). CFO-Het, measured as the full-width at half-maximum (FWHM) of a GL/CFO profile, has been shown to corroborate the bending load history in the chimpanzee proximal femoral shaft (Keenan et al. 2011 AAPA). Based on this previous chimpanzee study, greater CFO-Het in compression "cortices" was also expected in the human femur. Twenty-four sections from 12 adult human proximal femoral shafts were

embedded in methacrylate, ultramilled, and imaged in CPL. FWHM was measured from CFO profiles (larger FWHM = greater CFO-Het). Statistical analysis was based on the: 1) left peak (LP), 2) right peak (RP), and 3) average of both peaks (AvgP) of the CFO profile of each image. Results show highest CFO-Het in the medial "compression" cortex when considering the LP ($p < 0.05$), but is unexpectedly highest in the lateral "tension" cortex when considering the RP and AvgP ($p < 0.05$). Although CFO-Het correlates moderately with CFO for the RP and LP (RP: $r = 0.5$, $p < 0.001$, LP: $r = -0.6$, $p < 0.001$), there is no correlation with AvgP data ($r = -0.1$). While CFO-Het clearly corroborates CFO-based load history data in chimpanzee femora (greater CFO-Het in "compression" cortices), CFO-Het does not clearly reflect this load history in human proximal femora. This may reflect difficulties in quantifying CFO-Het based on the presence of two CFO peaks in human femora (chimpanzees = one peak). Consequently, CFO-Het does not appear to be useful for predicting a history of bending in these bones.

Genome-wide Complex Trait Analysis (GCTA) as a method to quantify missing heritability in Parkinson's disease.

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Genome-wide association studies have been successful at identifying SNPs highly associated with common traits, however a great deal of the heritable variation associated with common traits remains unaccounted for within the genome. Genome-wide Complex Trait Analysis (GCTA) is a statistical method developed by Peter Visscher used to estimate phenotypic variance of complex traits explained by genome-wide SNPs, including those not associated with the trait in a Genome Wide Association Study (GWAS). We applied this method to 8 cohorts containing 6,057 case and 17,471 control individuals of European ancestry, in order to examine the missing heritability present in Parkinson's disease, a neurodegenerative disorder affecting between 1-2% of individuals over the age of 65. We meta-analyzed our initial results to produce more robust and generalizable heritability estimates for PD types. Our results identify 36% ($p = 6.47E-06$) of phenotypic variance associated with all types of PD, 51% ($p = 3.91E-04$) phenotypic variance associated with early onset PD, and 39% ($p = 2.55E-05$) phenotypic variance associated with late onset PD. This is a substantial increase from the genetic variance identified by GWAS alone (between 1-3%). Our results suggest that while GWAS is a useful tool in identifying some of the most common variants associated with complex disease, a large portion of the heritability associated with disease traits remains unattributed.

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The social organization of *Lemur catta* in the region of Cap Sainte-Marie, Madagascar.

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Perceptions of "typical" *Lemur catta* behavior are based primarily on captive and gallery forest studies. The objective of this study is to compare assumed species-typical behaviors with data collected during a long term study on this species in a completely different environment: the semi-desert conditions of Cap Sainte-Marie (CSM), Madagascar. The specific behaviors that are investigated include 1) activity budgets, 2) agonism trends, 3) group cohesion patterns, 4) dyadic bonds, and 5) adult to immature relationships. Data have been collected on two different troops through all day follows using focal animal and scan sampling methods. Over 1,019 hours of behavioral data are included in the analyses.

Relative to other populations, CSM *Lemur catta* are highly social, and immatures are central to troop dynamics. In fact, a major form of agonism in one troop especially seems akin to socialization. Conversely, while female targeted aggression is not a primary agonistic form with these troops, there is also an absence of strong female dyads. Last, there are consistent affiliative interactions between resident males and troop immatures, and no males dispersed from one troop during the 15 months of observations. Based on these findings, I conclude that the social organization of CSM *L. catta* is largely shaped by two factors: 1) a lack of multigenerational matriline and 2) a near absence of inter-troop contact. I also propose that *L. catta* may be predisposed for behaviors such as paternal care, but that these behaviors are typically suppressed in other studied troops because of these factors.

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Bioarchaeological analysis of unlooted tombs from Cocahuischo in Nasca, Peru (AD 650-750) reveals disease and trauma patterns during the period leading up to Wari Imperial incursion.

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The latter portion of the Early Intermediate Period in Nasca, Peru (AD 650-750) was characterized by burgeoning social and trade networks before the expansion of the Wari and Tiwanaku states. The Nasca were important to the Wari state, as evidenced by similarities in ceramic technology and iconography. Even with these associations, recent archaeological and bioarchaeological studies have revealed variation in the Nasca response to Wari incursion.

Ten individuals from nine unlooted tombs from Cocahuischo, one of the largest sites in the region during this time period and located near the later Wari outpost of Pataraya, were excavated and analyzed. Almost all individuals

exhibit the Nasca fronto-occipital style of cranial vault modification and are seated flexed facing south. The most common pathology is antemortem tooth loss, but few individuals show evidence of osteoperiosteal reactions. Osteoarthritis, spondylosis, Schmorl's nodes, and postcranial fractures attest to the hard physical activity characteristic of Nasca lives. One tomb also contained a rare headless burial of a young male and may clarify the practice of Nasca "trophy" head taking. These bioarchaeological analyses contribute new data on Nasca individuals during a period of great social change.

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Low, sexually-monomorphic digit ratios in a wild strepsirrhine primate (*Microcebus rufus*).

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The relative lengths of the second and fourth digits (2D:4D) are considered a marker for prenatal androgen exposure. Lower ratios are generally characteristic of males in humans and anthropoid primates, and have been correlated with a wide range of presumably androgen dependent behavioral and morphological traits within species (increased aggression, dominance and physical size) as well as between species (increased intrasexual competition, reduced pair bonding). 2D:4D sexual dimorphism is well characterized in humans and reported for several anthropoids, however the data presented here represent the first assessment of digit ratios in a strepsirrhine, the brown mouse lemur (*Microcebus rufus*). Due to the female dominance and overall sexual monomorphism typical of lemurs, and the comparable levels of fecal testosterone in this species' males and females, we expected to find no evidence of dimorphism. Digital measurements of rays were taken and all potential ratio combinations analyzed for male ($n=28$) and female ($n=21$) brown mouse lemurs in a wild population in Ranomafana National Park, Madagascar. No sexual dimorphisms were found (p values between 0.38 and 0.82). However, the low 2D:4D (0.75) of these polygynous lemurs fits well with the negative correlation established between intrasexual competition and 2D:4D in anthropoid species, despite the typically strepsirrhine manual ectaxy of *M. rufus* and the mesaxy of the anthropoid species. Implications for comparisons of a full range of digit ratios within and between groups with mesaxonic and ectaxonic hands will be discussed.

Sex estimation using pubic bone morphology in a modern South African sample: a test of the Klaes *et. al.* method.

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The morphology of the human innominate is often cited as the most reliable skeletal elements for sex estimation. Establishing sex of an unknown individual is a vital component of biological profile estimation and is necessary for the assessment of the other components of the profile. The Klaes *et al.* method (*in press*) expands upon the three morphological traits of the pubic bone (medial aspect of the ischio-pubic ramus, subpubic concavity, and ventral arc) described by Phenice (1969) and separates each of the traits into five expressions that are scored on an ordinal scale. The present study tests the utility of this newly proposed method on a modern South African population.

A total of 105 (44 female, 61 male) left os coxae from the Pretoria Bone collection housed at the University of Pretoria, South Africa were scored following the descriptions and images presented by Klaes (2009). All adult individuals scored were above the age of 18 at the time of death and did not exhibit any pathological conditions affecting the bone. The scores were compiled and examined through discriminant function analysis in Fordisc 3.1's custom database (Jantz and Ousley 2005). A cross-validated accuracy of 96.2% correct sex classification was achieved and is comparable to the results found by the original authors. The Klaes *et al.* method has been shown to be applicable to a modern South African sample and in populations beyond the original study sample.

Manual graminivory and feeding rates in gelada baboons.

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Grazing theropithecines were once widespread and abundant in the Plio-Pleistocene; today, however, only gelada baboons (*Theropithecus gelada*) practice manual graminivory. Given the diversity of ancient grazing primates, possibly including hominins (i.e., *Paranthropus boisei*), it is surprising that the mechanisms of foraging in *T. gelada* have not been explored in more detail. Here we use mixed-effects models to preliminarily evaluate the determinants of feeding rate (plucks/second) in 40 adult and juvenile gelada individuals from the Guassa Plateau population in northern Ethiopia over a two-month period. We found that pluck rate decreased with plucking bout duration only for certain graminoids and herbs, indicating bout termination was not consistently associated with patch depletion. Adult sex interacted with food category to influence pluck-rate. Males plucked herbs 13% faster than they did graminoids, whereas females plucked graminoids 12% faster than they did herbs. Males plucked herbs 21% faster than females, but there was no difference between sexes for graminoid pluck rates. When subterranean components (e.g., bottoms or roots) were included in a feeding bout, pluck rates were significantly lower ($p < .0001$), suggesting plant physical properties, including stem and blade toughness, constrain

harvesting rates. The maximum number of plucks for a given food item tend to scale with body mass and thumb length. Given that intrinsic hand proportions (IHP) were relatively similar between grazing fossil theropithecine species, we suggest that IHP evolution early in the *Theropithecus* lineage played a key role in the success of the genus.

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Interpreting sex differences in dental caries among prehistoric Late/Final Jomon period people from Japan: regional perspectives on dietary variation and reproductive ecology.

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This study documents dental caries prevalence between males and females from Late/Final Jomon period Japan and interprets the results within regional context. Late/Final Jomon period people from Honshu Island consumed elevated amounts of cariogenic plant food mixed with maritime and terrestrial animals, while those from Hokkaido had a diet that was rich in marine resources. Both regions had similar population density. If differences in caries prevalence between the sexes are attributable to reproductive ecology, then significant differences in carious tooth frequencies should be observed between males and females from Hokkaido and Honshu. Individuals from Honshu and Hokkaido were divided into three age groups based on tooth wear. Prevalence of dental caries was compared between males and females from these regions using a Fisher's exact test. Significantly greater frequencies of carious teeth are observed between males and females from Honshu Island in all age groups for molariform teeth (AG1: $P < 0.036$, AG2: $P < 0.0014$, and AG3: $P < 0.0001$). Frequencies of carious teeth are not significantly different between males and females from Hokkaido Island in any age or tooth group. The results indicate that differences in caries prevalence between Late/Final Jomon period males and females primarily reflect dietary variation. Based on these conclusions and the discourse regarding sex differences in caries prevalence, this study advocates moving away from a foundation of "knowledge gatekeepers" within the bioarchaeological community towards the free exchange of ideas grounded in the scientific method, and as mentioned by earlier work, regional contextualization of results.

Paternal kin recognition in female, captive, grey mouse lemurs (*Microcebus murinus*).

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Paternal kin recognition may enable females to avoid mating with close male kin, however the proximate mechanisms underlying such recognition are difficult to determine. We investigated both the production and perception of mate advertisement calls in grey mouse lemurs (*Microcebus murinus*) housed at the University of Veterinary Medicine Hanover. We performed acoustic analyses to test whether males produce mate advertisement calls that are distinctive by kin group. We analyzed 49 spectral and temporal variables in 10 calls from each of nine males, representing three patriline. We conducted a principal components analysis of the acoustic variables and put the resulting component scores into a permutated discriminant function analysis (pDFA) with a nested design (individual nested within patriline) and found that 80% of the calls were accurately classified by kin group. We conducted playback experiments to investigate how nonestrous females ($n=10$) perceive and respond to mate advertisement calls from their fathers and unrelated males. We performed principle components analysis on the 11 behavioral variables measured during playback experiments (e.g., time spent looking toward the speaker, latency to approach speaker) and put the resulting component scores into Bonferroni corrected Wilcoxon paired sample tests. Nine of the 10 females paid more attention to calls from their fathers than from unrelated males. Thus, males produce calls that are distinctive by patriline and nonestrous females respond differently to calls from paternal kin and nonkin. This is the first test for vocal recognition of kin in a nongregarious, nocturnal strepsirrhine primate.

Palaeopathology and urban decline at Imperial Gabii (Italy).

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The ancient Italian cities of Gabii and Rome urbanized in parallel just 12 miles apart. Whereas Rome continued to expand throughout the Imperial period (1st-4th centuries AD), Gabii began to decline in the Late Republic (1st century BC). In 2009, excavations at Gabii revealed numerous Imperial-period graves within the city walls, a pattern that supports the decline and abandonment of the city in Imperial times.

Skeletal remains of 26 individuals were analyzed in order to learn more about the use of the city in Imperial times and the population buried therein. Demographic analysis shows a relatively equal sex ratio, but there are no subadults between 2 and 18 years of age, quite unusual for an Imperial cemetery. Pathological analysis of the skeletons revealed stressful lives for the Gabines. With a caries true prevalence rate (TPR) of 8.2% and high frequencies of dental calculus (73% TPR), abscesses (3.3% TPR), and antemortem tooth loss (11.6% TPR), the Gabine population had much poorer dental health than previously reported suburban populations. Surprisingly few infant remains yielded evidence of porotic hyperostosis (6.9%), but those that did had very severe lesions.

The bioarchaeology of Gabii is yielding new information on urban development and

collapse in Latium. People were likely buried in the city center during a time of population contraction, and their physically stressed skeletons suggest that life for the lower classes at Gabii was difficult, even more so than for people living in other areas of the Roman suburbs.

Social evolution in the Upper Mun River Valley, Thailand: using isotopic, non-metric and geometric morphometric evidence to elucidate past social structures.

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Social structures can be difficult to pinpoint in the archaeological record, as they do not leave obvious material traces. As archaeologists we can look at mortuary wealth and correlate this with social hierarchy, but studies have shown that this is not always the best interpretation of the evidence. In this study we look at multiple lines of osteological evidence in order to better understand prehistoric social systems at the site of Ban Non Wat, in the Upper Mun River Valley of Northeast Thailand. As one of the largest cemetery samples in the country, spanning from the Neolithic (approximately 1750BC) through to the Iron Age (around 100AD), this site has huge potential to shed light on social evolution during prehistory. We have conducted isotopic analysis on dental enamel from over 200 individuals from the site, evidence from these analyses has been combined with data associated with genetic relatedness; dental non-metric traits and cranial shape analysed using geometric morphometric analysis. These techniques give an idea of kinship groups within the site and can be related to patterns seen within the isotopic results. Our current results indicate an intrinsic growth in population throughout the site's history. We also find evidence for strong sex-based differences in the Neolithic periods, prior to the emergence of rank-based hierarchy in the Bronze Age.

The efficacy of traditional dental lifestyle markers in describing actual lifestyle.

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Traditionally, osteological markers have been used to reconstruct lifestyle patterns, even in the absence of concrete archaeological evidence indicative of particular behaviors. This assumption rests on the notion that the shift from hunter-gatherer to agricultural lifestyles is generally linear, with quality of life decreasing with the adoption of sedentism. Here, we explore the accuracy of this assumption by evaluating the incidence of dental markers of diet and nutrition recovered from over 300 worldwide sample populations in the published literature. Our analyses indicate a nuanced and complex relationship between marker incidence and lifestyle. Average caries incidence is higher

among agriculturalists (12.3%) than among terrestrial and marine based hunter-gatherers (3.3% and 4.05%, respectively). However, the range of incidence of caries between lifestyles overlaps considerably, and it is impossible to discriminate between lifestyles based solely on this. Similarly, abscesses show an increase in rates between terrestrial and marine hunter-gatherers (3.0% and 4.3%) and agriculturalists (9.32%), again with large overlaps in the range. However, AMTL rates between agriculturalists (17.8%) and terrestrial hunter-gatherers (15.2%) do not vary greatly, with a significant difference existing between these groups and marine hunter-gatherers (7.5%). Linear enamel hypoplasia incidence is actually highest in terrestrial hunter-gather populations, with a rate of 29.4%, as compared to 26.6% for marine hunter-gatherers and 22.1% for agriculturalists. In conclusion, the incidences of these markers cannot be correlated exclusively to traditionally defined subsistence patterns. Due to their complex and multi-factorial etiology, we stress that they should only be interpreted in context with archaeological data.

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Isotopic evidence of hominoid paleoenvironments and diets from Napak and Moroto, Uganda.

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Early Miocene sediments exposed along the flanks of the extinct Moroto (>20.6 Ma) and Napak (~20 Ma) volcanoes in Uganda have yielded extensive fossil assemblages that document the early stages of a transition from archaic to more modern East African faunal communities. Included in this transition is the earliest recorded diversification of the hominoid clade, as exemplified by the taxa *Morotopithecus* and *Proconsul*, for whom locomotor and dietary distinctions have been inferred. As part of ongoing research to establish the environmental factors associated with these evolutionary events, and to further elucidate adaptive strategies, we are developing an isotopic template of fossil herbivore dietary guilds to constrain aspects of paleovegetation and paleoclimate. Bulk isotopic analyses of enamel C and O from 130 specimens of variable herbivore taxa (including suiforms, pecorans, rhinoceros, proboscideans, primates, and anthracotheres) from multiple sites reveal dietary variability partitioned spatially and temporally in the sequences. Despite the fact that the paleohabitats were dominated by C₃ vegetation, isotopic signatures of fossil taxa reveal diverse and complex foraging patterns suggesting habitat heterogeneity. Overall, the C isotopic dietary signatures of enamel range from -6‰ to -14‰, less depleted than values characterizing modern fauna in closed canopy forests, indicating relatively open forest ecosystems at some sites. Bulk isotopic analyses of fossil enamel from *Morotopithecus* and *Proconsul*, evaluated in the context of modern hominoid isotopic signatures, indicate variable

foraging strategies in more open forest habitats than is typical of extant apes.

Antemortem tooth loss, tooth wear, and dental trauma: learning more from the Gombe chimpanzees.

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Tooth wear is a function of both age and diet. Among the Gombe chimpanzees, tooth wear has been considered the primary cause for periodontal disease, abscess formation, and antemortem tooth loss (Kilgore 1989); I examine the possibility that factors other than tooth wear may influence antemortem tooth loss in chimpanzees (*Pan troglodytes*).

Antemortem tooth loss is of interest for assessing health status in terms of nutritional and other health consequences (e.g., systemic spread of an infection that caused an abscess). From a theoretical standpoint, antemortem tooth loss is significant because of its possible implications for conspecific care and interpreting the evolutionary role of senescence.

I expand Kilgore's (1989) study of 10 chimpanzees from Gombe National Park, Tanzania, to include 23 adult chimpanzees (10 males, 13 females) and compare tooth wear and antemortem tooth loss patterns to 99 adult chimpanzee skulls (25 males, 74 females) from the Powell-Cotton Museum (Birchington, Kent, UK). Both samples show that while severe tooth wear (Kilgore's stages 6-8) is correlated with antemortem tooth loss, the correlation is weak, indicating that tooth wear is not the only factor that influences antemortem tooth loss. Case studies from Gombe clearly demonstrate that trauma may play an important role in antemortem tooth loss for chimpanzees. Trauma may result from mastication, falls, or conspecific violence.

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Petrosal anatomy of *Afradapis longicristatus* (Primates, Adapiformes).

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Afradapis is a large (2-3 kg) adapiform primate known from the early late Eocene BQ-2 locality in the Fayum Depression, Egypt. Here we report the discovery of two isolated petrosals from BQ-2 that are referable to *Afradapis* based on size and morphology. Both petrosals preserve portions of the canals for the facial nerve and branches of the internal carotid artery. As in other adapiforms, the internal carotid enters the middle ear posterolaterally near the stylomastoid foramen, and the stapedial and promontory canals divide on the promontorium infero-medial to the fenestra cochleae. The stapedial and

promontory canals are nearly equal in diameter and follow the "transpromontorial" route that is probably plesiomorphic for crown primates. In these features, *Afradapis* is similar to many adapiforms and omomyiforms but differs from crown haplorhines. The preserved portions of the facial canal are unremarkable except in one respect: the hiatus Fallopii (intracranial exit for greater petrosal nerve) is very large, exceeding the diameter of the facial canal by 30-50%. It is likely that the geniculate ganglion was lodged in this large opening, as occurs in 5% of humans. This peculiar morphology is apparently typical for *Afradapis* because it is preserved in both known specimens, but is not seen in other adapiforms. Both specimens also demonstrate that the mastoid was heavily pneumatized, as in adapines and *Mahgarita*. The petrosal anatomy of *Afradapis* is consistent with its previous placement as a derived adapiform stem strepsirrhine, and provides no evidence for a phylogenetic link with anthropoids.

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Sexual dimorphism in the 12th thoracic vertebra in human skeletal remains.

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This study examines the presence and extent of quantifiable sexual dimorphism in the 12th thoracic vertebra, and explores the effects of age on morphological variation and sex estimation. Temporal variation and secular effects are also evaluated in order to address non-genetic alterations and influences on the skeletal morphology. The 12th thoracic vertebra, femur and sacrum of 168 (94 males and 74 females) mature South African Blacks from the Raymond Dart Collection (University of the Witwatersrand, Johannesburg, South Africa) and 407 (205 males and 202 females) mature African American skeletal remains from the Hamann-Todd Collection (Museum of Natural History, Cleveland, Ohio) were analyzed. The inclusion of both samples also facilitated an examination of geographical variation within and between populations.

The morphology of the 12th thoracic vertebra was investigated using stepwise regression and discriminant function analyses. The results demonstrate that 82% of South African males and 83% of South African females correctly classify for sex using this methodology. Among the sample of African American males and females, a total of 86% were correctly classified. Though it appears that age-related changes have little effect on the level of correct classification of sex in the African American sample, age-related changes reduced correct classification in the South African sample. Although limited to two samples, this study suggests that the 12th thoracic vertebra has potential for use in sex estimation, and further research on additional samples is warranted.

The timescale and evolutionary dynamics of *Mycobacterium tuberculosis* infection in humans.

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The human bacterial pathogen *Mycobacterium tuberculosis* (MTB) is the causative agent of tuberculosis and is one of the leading single-agent causes of global infectious disease mortality, second only to HIV/AIDS. MTB is found throughout the globe and may infect as many as one-in-three individuals, which combined suggest a long evolutionary history of infection in humans. Indeed, prevailing hypotheses suggest that humans acquired this important pathogen prior to their out-of-Africa expansion more than 40,000 years ago, and that subsequent ancient human migrations are responsible for the present geographic distribution of *M. tuberculosis*. However, most evidence supporting the antiquity of MTB is indirect, and in the absence of direct evidence from the bacterium itself, it is unclear how assumptions about the antiquity of MTB may color our interpretation of existing evidence.

Interestingly, recent work in indigenous North American populations indicates that MTB accumulates diversity over short timescales and that previous assumptions about the low rate of MTB evolution must be re-examined. Herein, we analyze a large, novel data set of full MTB genome sequences to reveal and link the evolutionary dynamics of this critical human pathogen with human population history. Importantly, we estimate that the tempo of MTB evolution to be as much as two orders of magnitude faster than previously assumed. Critically, our estimates suggest that the most recent common ancestor of MTB existed as recently as several millennia ago, and that more recent shifts in human behavior are likely to explain the observed distribution of this potent human pathogen today.

Sex estimation using the mastoid process.

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This study assesses sexual dimorphism of the mastoid process in samples of African-Americans (AA) and European-Americans (EA). The mastoid process is a classically used indicator of sexual dimorphism in the area of bioarchaeology and forensic anthropology. Variation in size and shape of cranial elements, including the mastoid process, has been found to differ significantly between populations. This study uses a sample of 55 AA females, 50 AA males, 49 EA females, and 49 EA males from the Hamann-Todd Collection at the Cleveland Museum of Natural History and the WM Bass Donated Collection at the University of Tennessee, Knoxville. Three measurements were taken on the mastoid process: height, width, and thickness. Results show that both AA and EA display sexual dimorphism in mastoid height and width, with males being larger. AA males have

significantly thicker mastoids than AA females, but EA males and females do not differ significantly. In both groups, mastoid width is the most dimorphic trait among the three measures. AA males are not significantly different than EA males in any of the three traits, but EA females have significantly thicker mastoids than AA females, but these two groups do not differ in the other two traits. These findings highlight the importance of considering population-based differences when assessing for sex.

Trabecular architecture of fossil hominin first metacarpals.

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Two hominin first metacarpals – SK 84 and SKX 5020 - from Swartkrans have been the centre of much debate regarding both their taxonomic affiliation and their potential inference for stone tool-making in early hominins. Variation in size and external morphology has led some to attribute these fossils to different species; SK 84 as early *Homo* and SKX 5020 as *Au. robustus*, but attributing tool-making ability to both. In contrast, others feel such variation can be accommodated within a single taxon and, if both are considered early *Homo*, tool-making ability is constrained to the genus *Homo*.

Here we address this debate from a new perspective using micro-CT and an analysis of trabecular bone structure. We investigate variation in trabecular architecture in these fossils in comparison with *Au. africanus* StW 418 and an extant sample of *Pan* ($n=15$) and *Homo* ($n=10$). Compared with SK 84, SKX 5020 is more similar to humans in having higher trabecular separation, lower trabecular number and a lower degree of anisotropy in the first metacarpal head, though all fossil specimens are generally more similar to *Pan* than the derived condition of recent humans. These results suggest that if SK 5020 and SK 84 do not belong to the same species, then it may be more reasonable that SKX 5020 be attributed to early *Homo*, rather than SK 84. General similarity of all fossils to *Pan* indicates that there is not a clear tool-making signal in the trabecular structure of either specimen.

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Identifying sharp force defects: an analysis of ambiguous skeletal trauma recovered from the wreck of the royal Swedish battleship *Kronan*.

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In 1667, the Swedish battleship *Kronan* with a crew of 850 men encountered the pursuing Danish-Dutch fleet in the Baltic Sea. Historic accounts report that the battleship turned too quickly, keeled over, and powder magazines aboard exploded. The ship quickly sank, taking with her 808 men. *Kronan* rested on the sea floor for over 300 years before being rediscovered in 1980, and commingled human remains were salvaged. A cursory analysis in 1997 by Professor Ebba During at Stockholm University found perimortem traumatic defects on approximately 10% of the 260 skeletons recovered. She proposed the injuries likely resulted from either sharp force violence or explosive trauma. No conclusive determination was made regarding trauma type, and no further analyses were conducted on the material.

This current project was undertaken to better define the trauma type, degree, and patterning present on a number of the skeletal elements. Using standard forensic anthropological protocols, a representative sample of 20 isolated bone elements (or 14% of the total number of bones with defects present) was analyzed in order to distinguish between sharp force and blast trauma. The results show that these injuries are consistent with sharp force trauma only. Surprisingly, no evidence of blast force, percussive, or explosive injuries were noted within this collection. The presence of sharp force injuries is intriguing, since it is documented that no man-to-man combat occurred prior to the sinking of the vessel, and no previously injured sailors were aboard. The cause of the sharp force trauma is still unknown.

Secular change in the human innominate: from the 19th to the 20th century.

ALEXANDRA R. KLALES. Department of Anthropology, University of Manitoba.

The purpose of this research was to examine the magnitude and direction of secular changes in the human innominate. To assess these temporal differences, a sample of 211 left, adult innominates of documented sex and ancestry was used from the Hamann-Todd Collection, composed of individuals born during the 19th century, and also from the W. M. Bass Donated Collection, composed of individuals born during the 20th century. Data were collected from males and females of two populations: American Blacks and American Whites.

Twenty-two 3D landmark coordinates of the innominate were collected for each individual using a digitizer. From these coordinates, geometric morphometric analysis was performed to assess shape changes. The raw coordinate data was first subjected to a Procrustes fit to scale, rotate and translate the data to Procrustes coordinates. Using the Procrustes coordinates, the combined, cross-validated percent correct classification between the two temporal periods using linear discriminant function analysis was 99.1%. Because of high classification accuracy, specific differences in pelvis dimensions were explored further. Although there are limitations of sample size for one subset, further analyses controlling for sex and ancestry further separated groups by temporal period, suggesting that secular change in the human innominate occurred.

Surfacing from the wake of conquest: regional diversity in biocultural responses to European colonization in Northern Peru.

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The transition to the colonial world in the Americas was once envisioned as a process of native demographic collapse and population extinction. Bioarchaeological research instead continues to reveal a diverse range of outcomes to conquest. Following the first phase of our long-term investigation into the postcontact adaptive transition in Mórrope, the focus of the Lambayeque Valley Biohistory Project shifted to Eten, and included excavation of two church ruins over three field seasons (2009-2011) producing a sample of 475 Early/Middle and Middle/Late Colonial burials that reveals complex and contrasting native experiences within colonial Lambayeque. Initial analysis indicates the Muchik people of Eten were in some ways healthier than the people of Mórrope - they survived greater degrees of acute subadult stress (measured by linear enamel hypoplasias) and experienced less childhood anemia and chronic adult infection. Much of this may owe to the unique and diverse biotically-rich microenvironments of Eten. Oral health data suggests the Eten population consumed a diet low in carbohydrates and high in marine resources. Paradoxically, four mass graves in Eten point to high mortality events that were not observed in Mórrope. Eten also includes qualitatively more severe osteoarthritis, activity-related injuries (broken ribs and femoral neck fractures), and examples of deadly interpersonal violence experienced by children. This paper provides a first glimpse of a significant and previously unknown range of colonial experiences in the Lambayeque Valley faced by the first generation of the survivors of conquest and their descendants.

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Field-testing global positioning system (GPS) collars on long-tailed macaques (*Macaca fascicularis*) in Singapore: evaluation of tracking ability in mixed rainforest habitat.

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Here we report on a field test of satellite global position system (GPS) collars on two

long-tailed macaques (*Macaca fascicularis*) in Singapore. Our goal was to assess the feasibility of collaring primates in complex forested and anthropogenic habitat. We recorded the locations of 2 individuals over a 4-week period in and around Bukit Timah Nature Reserve. The collared individuals were from distinct social groups occupying adjacent home ranges. The collars recorded location, satellite data, and temperature every 10-15 minutes during daylight hours and every hour over night. The GPS position acquisition rate was high relative to studies carried out on mammals in similar mixed forest habitat and comparable to those recorded for primates utilizing open habitat. The GPS fixed a position in >98% of positioning attempts for both collars (N = 2491 attempts), with average time required to obtain a reading being less than a minute. The near 100% fix rate combined with an average of over 6 satellites for each position fix provided us with very high accuracy in the GPS positions recorded. Despite residing in adjacent groups the two collared macaques showed minimal overlap in range use, but used multiple habitat types within the ranges. Given the collar's strong reliability, spatial accuracy, and low impact on the study animal, our results open up new methodological and analytic possibilities for future utilization of GPS technology to research ranging patterns of primates in complex habitats.

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Jaw shape diversity in Platyrrhine 'sclerocarpic foragers'.

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Sclerocarpic foraging refers to the harvesting of fruits and seeds that are protected by resistant outer skins. Accessing the foods within requires specialized incisors, canines and, perhaps, postcanine teeth. Pitheciines (*Cacajao*, *Chiropotes*, and *Pithecia*), as well as *Callicebus* and *Aotus*, share dental adaptations for this purpose, though the larger pitheciines alone have large splayed canines and a wedge-like incisor battery. They crack hard seeds and pry open more resistant fruits than those eaten by the smaller *Callicebus* and *Aotus*. This study extends our understanding of the morphological correlates of sclerocarpic foraging by investigating mandibular morphology using 3D Geometric Morphometrics. The results demonstrate that seed-eating pitheciines are distinguished from the smaller taxa by characteristics associated with powerful unilateral biting, such as proportionally larger, increasingly thick and sloping symphyses. Their mandibles are consequently better designed for resisting dorsoventral shear and other stresses at the mandibular symphysis. Among the smaller

taxa, *Callicebus* has a deeper, narrower mandible overall and more robust symphysis in cross section than *Aotus*. *Callicebus torquatus* best exemplifies this pattern, and has been reported to consume more seeds than other species of *Callicebus*, or than *Aotus*. Though lacking the specialized anterior dentition of pitheciine seed predators, *C. torquatus* jaw shape is suggestive of adaptation for eccentrically loaded, powerful unilateral biting. Thus, they may offer a useful model for understanding the evolution and diversity of sclerocarpic foraging strategies and the emergence of the more highly modified pitheciine seed predators.

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Drifting osteons seem unlikely to be a mechanical adaptation in view of inconsistent regional distributions and overall low prevalence in adult chimpanzee and human femora.

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Drifting osteons (DOs) are common osteon variants that might have important mechanical or metabolic functions. As shown previously, DOs are more prevalent in "tension" cortices of chimpanzee proximal femora, but did not exceed 11% of the total osteon population density (OPD) (Keenan et al. 2010 AAPA). Based on this previous study, we expected an increased prevalence of DOs in "tension" cortical regions as an adaptation for the inferior mechanical properties in tension compared to compression. Twenty-four sections from 12 modern adult human proximal femoral shafts were embedded in methacrylate, ultramilled, and imaged in circularly polarized light. DOs were identified/counted using published methods, and percentages of DOs (%DOs = #DOs/OPD) were obtained for each image. Unexpectedly, more DOs were found in the medial "compression" cortex of the proximal shaft ($p < 0.05$). The relatively small %DOs (4.04% + 4.39%; range: 0%-27.1%) is similar to our findings in chimpanzee femora. But the regional differences in human femora are opposite to our previous findings in chimpanzee femora (human femora = more DOs in medial "compression" cortex; chimpanzee femora = more DOs in lateral "tension" cortex). These results reduce the likelihood that drifting osteons are an important toughening mechanism, at least not in the context of regionally prevalent/predominant tension vs. compression. If there is a preferential mechanical or metabolic 'purpose' for DOs, then it has not been discovered. It may be that DOs are sporadic manifestations of the plasticity of a remodeling process and as such have little metabolic or mechanical functions in adult osteonal bone.

C-peptide and the cost of reproduction in Bornean orangutans.

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In energy-limited environments, life history theory posits a trade-off between reproduction and maintenance of physiological condition. However, obtaining a measurement of this trade-off is challenging. C-peptide, a product of the conversion of pro-insulin to insulin, has been shown to be a reliable indicator of energetic condition in wild apes. Here we use this tool to test hypotheses about the relative cost of reproduction in both male and female wild Bornean orangutans. Results come from over 2000 samples collected at Gunung Palung National Park, in West Kalimantan, Indonesia from 1994 through 2011. In females, we found highest C-peptide values in non-lactating, non-pregnant females, supporting our prediction that freed from the cost of reproduction females are able to maintain highly positive energetic status. Significantly lower C-peptide values were found in lactating females, supporting the prediction that this is the most energetically draining stage for females. This contributes to our understanding of why orangutans have such long inter-birth intervals as they may take many years to regain positive energetic status. Interestingly, pregnant females were able to maintain relatively high C-peptide levels. This may reflect a similar mechanism as found in humans, where women are able to add fat reserves during pregnancy to support the cost of lactation. In males we found that prime, flanged male orangutans exhibited the highest C-peptide levels, reflective of their good condition. In contrast, flanged past prime males, exhibiting deteriorated physical condition, had the lowest C-peptide values recorded. Unflanged males were able to maintain relatively neutral levels.

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Human remains processing for skeletal collections using laboratory "burials."

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Museums, laboratories, and law enforcement agencies curate the skeletons of contemporary humans for research, teaching, and medicolegal purposes. However, the process of rendering a human from body to bone can be challenging, especially when dedicated tracts of land are not available to allow remains to decompose naturally. Without burial, marrow fat can remain in bone and, over time, become destructive to bony tissues. Our experiments with non-toxic methods of maceration for long-term stable curation of twenty-eight human skeletons have yielded a process that involves mechanical tissue removal, serial hot water baths with enzymatic detergent, and laboratory "burials" – the placing of bones for three months in plastic tubs filled with dirt. This procedure derives from the observation that taphonomic burial processes naturally remove marrow fats from bone over time. While in soil, these

laboratory burials have no special temperature or humidity requirements, and are stored in a space where other anthropological cases are also stored, processed, and analyzed. Our process is relatively simple and inexpensive, which allows bones to be housed in perpetuity with minimal space requirements. This method can be useful for anthropologists developing museum collections as well as for forensic anthropologists, medical examiners, and coroners so they may maintain collections for forensic analysis and identification.

Optimal trait scoring for age estimation.

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The optimality of a trait scoring system for age estimation often is defined in terms of lower observer error, which explains, for example, preference for Demirijian et al.'s scoring system for dental formation over Moorrees et al.'s. But as Ed Harris (2007) points out in the AJPA, observer error studies for ordinal categorical traits will always find that decreasing the number of stages reduces the error level. We argue for testing the distributional assumption in "transition analysis" instead of using observer error studies to find optimality. We extend a previously described Lagrange multiplier goodness-of-fit test to consider all possible ways of collapsing ordered scores into smaller sets of stages, using Todd scores from 422 males in the Terry Anatomical Collection and from 495 females in either Terry or the Gilbert and McKern cast collection as an example. To enumerate all possible ways of collapsing stages, the problem is framed in terms of partitioning integers and forming permutations in light of possible ties. Looking at all 510 possible ways to collapse stages within males and females, we found that the probability of a revised system of Todd phases I, II, III, IV, V, VI and VII-X (combined) arising from a log normal transition model was 0.9962 for males and 0.7849 for females. In contrast, the scores from the original Todd ten-phase system and from the collapsed T2 six-stage system (Suchey and Katz 1986) yielded very poor goodness-of-fit statistics for both normal and log normal transition distributions.

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A biochemical marker for scurvy in archaeological bones.

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How is it possible to infer health from archaeological populations when only their bones remain? This much-debated osteological conundrum is well illustrated by scurvy. The disease must have been a common problem for past populations over-wintering on stored produce and particularly amongst the poor, yet the true scale of the problem is difficult to estimate. Despite extensive historical

documentation of this metabolic disease, there are several issues that confound identification of scurvy in archaeological bones. In addition sub-clinical cases, where a scorbutic episode was not sufficiently severe for the sufferer to develop visible boney changes, simply go undetected in the archaeological record.

Scurvy arises when levels of dietary vitamin C (ascorbic acid) are low, and if left untreated, results in haemorrhaging of weakened connective tissue. Vitamin C is essential for the hydroxylation of the amino acids lysine and proline, key structural components of collagen, itself a chief component of soft tissues and bone.

This paper presents a novel means of detecting scurvy, based upon the identification of certain bone collagen peptides, which contain hydroxyproline sites that are susceptible to deficiencies in vitamin C and thus represent a 'biomarker' for scurvy. The biomarker utilizes new advances in protein mass spectrometry and was developed using bone collagen from guinea pigs fed on low vitamin C diets and a series of well-documented archaeological cases of scurvy in humans.

Much of this research was conducted whilst the author was a bioarchaeology post-doctoral research fellow funded by the Wellcome trust.

Temporal trends in dental health and diet in the archaeological populations of Utah.

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As part of Utah State NAGPRA biological profile, dental health, radiocarbon dating and stable isotope data from a total of 58 adults representing the Archaic (~7,000 to ~2,500 ybp), Fremont (~2,000 to ~700 ybp), Anasazi (~2,000 to ~700 ybp), and Historic (~400 to 100 ybp) time periods have been collected. This data provides an opportunity to examine the relationship between dental health and diet, as indicated by stable isotope data, among the archaeological peoples of Utah. Each group practiced very different modes of subsistence. The Archaic groups were hunters and gatherers utilizing wild resources. The Fremont practiced mixed subsistence patterns with varying degrees of hunting/gathering and maize horticulture. The Anasazi primarily practiced maize horticulture. The Historic groups practiced primarily hunting/gathering with increasing utilization of historic Anglo food stuffs after the mid-nineteenth century.

It has been noted that populations dependent on maize tend to have higher rates of dental caries, abscesses, and antemortem loss than hunter/gatherer populations. For Utah populations it can be hypothesized that the Anasazi will have the highest rates of dental disease followed by the Fremont, Historic and Archaic groups in that order. Similarly it can be hypothesized among the Anasazi and Fremont individuals with greater dependence on maize will have higher dental disease rates than those with lower dependence. This poster will present correlation analyses using dental disease indicators, stable isotope data, age, sex, and population variables to test the hypotheses and

examine trends in dental health and diet among the archaeological populations of Utah.

From scientific specimen to indigenous cultural property: the collection and use of Australian indigenous DNA samples since the 1960s.

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Thousands of blood samples taken from Australia's Indigenous people lie in institutional freezers of the global North. In Australia and elsewhere, some of these collections were initiated in the 1960s by scientists eager to understand human biology and aided by technological changes in transportation and preservation that supported the transformation of body parts of indigenous peoples into the 'material culture' of biomedical science. For over 30 years, these samples, and the information derived from them, circulated through networks of scientific exchange. Through the decades samples have remained suspended in time, while outside the freezer both genomic science and research ethics have experienced profound transformations. Some indigenous donor communities in Australia and elsewhere now view samples not as scientific gifts but as cultural property and an extension of the collective indigenous body. While many scientists consider research on older samples as a universal good with potential to improve indigenous, national and global health, some indigenous people view such research as a neocolonial injury. Although some sample collections held outside Australia are still actively used for genetic research, this is viewed as maverick and unethical by most Australian genetic researchers who have closer relationships with Indigenous Australians, national bioethical norms and postcolonial politics. This brief paper explores these issues, drawing from an ongoing ethnographic study of indigenous DNA collections and genetic researchers who work in indigenous communities across Australia.

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A morphometric analysis of cranial ontogeny in the Hominoidea: implications for the growth and development of fossil primates.

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Many studies have applied information on African ape and human ontogeny to interpret the biology of fossil hominins. However, in the analysis of stem hominoids and hominids, data from all extant non-human apes are needed to model ontogeny. To this end, we use geometric morphometrics to investigate patterns of cranial growth in extant hominoids, including

hylobatids, for which very little data are currently known.

In order to examine growth allometry in hominoids, three-dimensional coordinates of 145 landmarks and 313 semilandmarks were measured on CT and surface scans from an ontogenetic sample of hominoid crania, comprising *Pan*, *Gorilla*, *Pongo*, *Hylobates*, and *Symphalangus*.

After Procrustes superimposition, principal component analyses were computed in shape and form space. We used regressions of shape coordinates on centroid size to assess within-group static and ontogenetic allometric trajectories.

We find that genus level differences are present in early life, and that the subsequent ontogenetic trajectories are almost parallel. This corroborates previous studies suggesting that many aspects of cranial development are shared among hominoids. In the first three principal components of shape space, *Pongo* specimens plot closely to the ontogenetic trajectories of the African great apes. *Hylobatidae* are distinctly different from all the great apes. However, as expected, *Hylobates* and *Symphalangus* plot close to each other in shape space.

We visualize and discuss aspects of cranial development that are shared among all hominoids as they are potentially informative about the development pattern of the last common ancestor of great apes and hylobatids.

This study is funded by the University of Toronto, the Max Planck Institute for Evolutionary Anthropology, and NSERC.

Minimum cost of transport and optimal velocity: what variables are predictive?

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Cost of transport (CoT) is the amount of energy that an individual uses to move a given distance, and for most extant animals, CoT has a minimum value (minCoT) that occurs at the optimal velocity. When applied to extinct species, this minimum is often used as a proxy of locomotor efficiency, because it represents the least energy that can be used to move. While much is known about the correlates of CoT in extant creatures, little work has been done to determine which, if any, morphological features predict minCoT and optimal velocity.

To rectify this, the energetic expenditure of 15 women was measured as they walked at 5 self-selected velocities. Standard anthropometrics were also measured. To this sample was added existing data from 79 people (including 44 children). Optimal velocity and minCoT for each individual was determined from the first derivative of the best-fit curve between velocity, velocity squared and CoT. Body mass predicted 66% of the variability in minCoT ($r^2=0.66$, $p<0.001$), but hip width ($r^2=0.61$, $p<0.001$) and calf circumference ($r^2=0.58$, $p<0.001$) were also effective. Optimal velocity was predicted by leg length ($r^2=0.56$, $p<0.001$).

From this, it seems clear that while the locomotor effectiveness of a person is influenced by their mass, how fast and, therefore, how far they move is a function of their leg length. If this trend holds for fossil hominins, size differences

need to be interpreted as indicators not simply of locomotor effectiveness, but also of daily range.

Anterior dental microwear textures of European Upper Paleolithic humans differed from those of Neandertals.

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The unique anterior dental wear pattern found on some Neandertal specimens has often been explained as non-dietary anterior tooth use, i.e., using the anterior dentition as a tool or third hand. While previous analyses have shown that not all Neandertals participated in these activities, comparative research has yet to be completed on European Upper Paleolithic (EUP) humans. Identifying differences or consistencies in behavioral strategies between these two European hominins is important, and can provide a unique view of the Middle to Upper Paleolithic transition.

Dental microwear textures were collected from high-resolution casts of over 30 EUP humans with a white-light confocal profiler using a 100x objective lens. Each individual is represented by four adjacent scans, totaling an area of 204 x 276 μm . The scans were uploaded into Toothfrax and SFrax SSFA software for surface texture characterization. The resulting data were then compared to my extensive Neandertal database of 65 individuals.

European Upper Paleolithic humans were homogeneous in their microwear texture signals. Overall, their anterior dentition was characterized by high anisotropy, moderately high fill volume, and moderate heterogeneity and complexity. These hominins likely did not participate in non-dietary anterior tooth use, and were exposed to moderate-to-high abrasive loads. This signal remained constant when the EUP sample was examined by climate, location, and MIS; however, the Neandertals differed significantly in all three of these factors. This suggests the EUP humans employed different behavioral strategies than Neandertals, perhaps related to a more extensive toolkit that released the anterior dentition from non-dietary use.

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Size and external morphology of the brains of the large fossil platyrrhines *Protopithecus* and *Caipora*.

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Protopithecus brasiliensis and *Caipora bambuorum* are large fossil platyrrhines from Pleistocene caves of Brazil. They were much larger than any extant platyrrhines with estimated sizes over twice the mean size of any extant New World monkeys. *Protopithecus* shows similarities to extant howling monkeys while *Caipora* resembles extant atelins.

Although the cranial and postcranial anatomy of the fossil monkeys have been described in several studies, to date there have been no descriptions of either the size or external morphology of their brains.

We measured the endocranial volume of the fossil crania of both taxa using pellets and a graduate cylinder. We also made endocasts of the fossil crania using liquid latex and compared the external morphology of these with endocast molds of a wide range of extant primates, including most platyrrhines.

The endocranial volume of *Caipora* (156 cm^3) was larger than that of *Protopithecus* (129 cm^3) even though *Protopithecus* was a larger taxon. Thus, *Caipora* had a greater Encephalization Quotient than *Protopithecus*. The endocasts show that *Caipora* had a more globular cerebrum than *Protopithecus* with a larger temporal lobe and more rounded frontal and occipital lobes. In overall shape, the endocast of *Protopithecus* resembles that of *Alouatta* whereas the endocast of *Caipora* resembles that of extant atelins such as *Ateles*. The development of sulci and gyri on the surface of the two endocasts was similar, but most sulci were longer in *Caipora*. The morphology of the brains of these taxa supports previous taxonomic allocations of *Protopithecus* with *Alouatta* and *Caipora* with *Ateles*.

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Conflict and ethnic identity among the post-collapse Chanka of Andahuaylas, Peru (ca. AD 1000-1400).

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State collapse is a tumultuous event which can spur striking and novel reformulations of group identity, but can also dramatically alter how people physically interact with one another. Sometimes, in the wake of fragmentation, this interaction can become violent. Yet violence may not be experienced equally by everyone; indeed some groups may be more vulnerable than others. This study specifically examines how the collapse of an ancient empire in the Peruvian Andes may have provoked periods of ethnocide within an emergent post-collapse society, known as the Chanka (ca. AD 1000-1400).

From 2009-2011, 315 crania from imperial and post-collapse eras were excavated from burial caves in Andahuaylas and assessed for evidence of violence, as well as salient skeletal indicators of ethnic identity. Physical conflict was inferred through patterns of healed and unhealed skull fractures; different ethnic groups were identified by the absence, presence, and style of cranial modification.

Results demonstrate a significant increase in non-accidental skull fractures between the Imperial (Wari) and Post-collapse (Chanka) periods, which suggest that violence in Andahuaylas became much more frequent following collapse. Moreover, deadly (unhealed) injuries are almost exclusively present on skulls that exhibit cranial modification. This suggests that the recognition of ethnic identity, marked as such by a modified skull, may have been a

primary cause for deadly attacks within post-collapse Chanka society.

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Human pelvic geometry in relation to body size and proportionality.

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Obstetric selection acts on the female pelvic canal to accommodate the human neonate and contributes to pelvic sexual dimorphism. Pelvic canal size is related to overall body size in some dimensions, though many obstetrically critical dimensions are not related to body size indicating that there is a complex relationship between selection for obstetric sufficiency and for overall body size in humans. The relationship between selective pressures may differ between populations of different body size and proportions. Pelvic canal dimensions have also been shown to vary among populations, perhaps to accommodate differences in body proportionality. The relationships among pelvic canal and body size and shape were examined using nine skeletal samples (total N = 277) from diverse geographical regions, representing a range of body size and proportionality characteristics. Pelvic, vertebral and long bone measurements were collected. Principle component analyses demonstrate pelvic and body size and shape differences among the samples; pelvic shape differences are clearer among the females. High latitude samples have larger and broader bodies, and pelvic canals of larger size and relatively broader medio-lateral dimensions compared to low latitude samples, which tend to display relatively expanded inlet antero-posterior and posterior canal dimensions. Despite this patterning in some characteristics, samples also differ in canal shape with no association to latitude or body size, suggesting relative independence of canal shape from body size and shape. These results contribute to an understanding of variation in pelvic shape among human populations in relation to obstetric pressures and geographic patterning in body shape.

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Revisiting dental age assessments in wild and captive *Pan*: new analyses of classic data.

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Accurately aging living and fossil primates is integral to human biology, palaeoanthropology, and related fields. The use of dental radiographic image data to estimate age in both living and skeletal primate samples is widespread. In humans, studies of dental

development and aging are available for very large, aged samples. Importantly, interpopulation variation is also relatively well-represented. However, this is not the case for apes such as the chimpanzee. With few exceptions, dental age assessments in chimpanzees have been hindered by a reliance on wild-shot and thus un-aged samples (usually skeletal material), small and cross-sectional data sets, and unbalanced sex distributions. Such methodological problems limit accurate age assessments in living or skeletal chimpanzee samples, and may contribute to the large differences in estimated ages reported between captive and wild chimpanzee samples.

This study revisits published methods for dental age assessment in chimpanzees to develop more robust approaches to aging using dental development data. We use dental stage scores for the left permanent mandibular teeth in an aged sample (from 1 to 11 years) of 118 captive chimpanzees, and an unaged wildshot sample of 75 chimpanzees and 44 bonobos. Using bivariate and multivariate regression models of ordinal-scale tooth development stage data, we evaluate age estimates of the permanent dentition against known age, dental maturity score, and age estimates based on single-tooth (e.g., M1) assessments. Comparison of regression parameters indicate that teeth completing maturity at later ages (i.e., C and M3) can be excluded in age assessment because of greater developmental variability.

Rancho La Brea Woman: a new 3D analysis of a 9,000-year-old Paleoamerican cranium from southern California.

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The Rancho La Brea Woman is the only human skeleton ever excavated from the La Brea Tar Pits in southern California. Dating to approximately 9,000 years BP, La Brea Woman is included in a rare group of skeletons, called Paleoamericans, who are distinguished by their considerable antiquity and distinctive cranial features. In 1962 Alfred Kroeber wrote that the La Brea Woman showed morphological similarities to prehistoric groups from Santa Barbara, California. Using the worldwide Howells database that employs linear cranial measurements to compare populations, researchers have recently demonstrated that La Brea Woman shows both similarities and differences to recent Native Americans and to other Paleoamericans. Given these varied results, and sophisticated new 3D techniques that allow for more detailed analyses, this study reexamines the La Brea cranium to determine if she differs from recent Native Americans. Female crania from nine of the earliest archaeological sites in California were scanned using a high definition 3D laser scanner. Cranial landmarks were recorded as x, y, z coordinates and subjected to geometric morphometric techniques. Cranial landmarks were superimposed to remove variation in position, scale, and orientation. Principal components analysis and cluster analyses (using both UPGMA and Ward's methods) show that La Brea Woman differs little from other females from the southern and central

California regions. The computed Mahalanobis distances indicate that La Brea Woman is most similar to females from the Phelps Mound and Tranquility archaeological sites in central California. These results have important implications for the early demographic history of prehistoric California.

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Exploring the differences in how long-tailed macaques (*Macaca fascicularis*) exploit human-modified environments: Do age and sex matter?

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Long-tailed macaques are found throughout Southeast Asia and have long been identified as an extremely flexible species associated with multiple habitat types, including human-modified urban environments. As resource overlap with humans increasingly puts humans and nonhuman primates in close contact, effective management strategies will require a more detailed understanding of how primates exploit urban ecosystems. We studied the feeding behavior of a single group of macaques in Bukit Timah Nature Reserve, Singapore to better understand age and sex-class differences in the use of human-modified habitats and human-derived foods. The macaques in this study regularly raid dumpsters, residential homes, gardens, and cars. We predicted that adult males would exploit modified landscapes more often than other age-sex classes, feeding more heavily on human-derived foods. We collected over 80 hours of scan and focal data from July-August 2011 recording activity, habitat type, height above ground, and food type. The study animals spent 71.1% of their time in modified habitats, but contrary to expectations, there was no difference in foraging height or in the use of modified environments (females=68.5%; males=74.3%; juveniles=70.7%); however, there was a significant difference in diet among age-sex classes [$\chi^2(4, N=63)=11.23, p=0.024$]. One-way comparisons revealed that males consumed marginally more modified/processed foods than females [$\chi^2(1, N=36)=2.88, p=0.0896$] and that juveniles consumed significantly more leaves and other plant material than either males [$\chi^2(1, N=47)=8.33, p=0.004$] or females [$\chi^2(1, N=43)=8.33, p=0.004$]. These results suggest that adult males may present the greater challenge to urban macaque management strategies than other age-sex classes.

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Never going back again? On the reversibility of mandibular symphyseal fusion.

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Complete ossification of the mandibular symphysis is a widely recognized synapomorphy of the crown anthropoid radiation and has evolved independently in other primate clades, including multiple times in Eocene adapids and subfossil lemurs. In contrast, decreases in ossification have yet to be documented in primates. The absence of reversals in anthropoids is particularly notable, given the age of this clade, its diverse array of feeding adaptations, and the fact that other primates show diet-related variation in fusion. This pattern suggests that once symphyseal fusion evolves, reversion to an unfused character state is unlikely. If correct, this hypothesis has important implications for functional and phylogenetic analyses. The goal of this study was to test this hypothesis in Chiroptera, a clade where fused and unfused symphyses are both common. Using a sample of 59 species of vespertilionoid and noctilionoid bats, we generated a molecular phylogenetic tree via Bayesian phylogenetic analysis and reconstructed ancestral states using parsimony and likelihood methods. We further evaluated character-state evolution using the BiSSE model in order to account for the effects of character-dependent diversification on ancestral-state reconstructions. Results indicate that reversals from fusion have occurred within the Chiroptera, highlighting the unusualness of the anthropoid pattern and suggesting that decreased joint ossification may be selectively advantageous in some contexts. Possible explanations for the lack of reversions in Anthropoidea include: functional influences unrelated to the initial dietary shift in basal anthropoids, selective neutrality in recent taxa, or developmental constraints related to the early onset of fusion in this clade.

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Caught in the act: nighttime activity in *Lemur catta*.

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Cathemerality is an activity pattern consisting of discrete periods of diurnal and nocturnal activity. Though uncommon within the vast majority of Primates, several Malagasy strepsirrhines, such as *Eulemur* and *Hapalemur*, maintain cathemeral activity patterns. Interestingly, several researchers have reported at least some nighttime activity in *Lemur catta*, yet this species is regarded as "strictly diurnal." As part of a larger study of *L. catta* feeding ecology in dry/spiny forest at Tsimanampetsotsa National Park, Madagascar, I used camera traps to examine cathemeral behavior in *L. catta*. From September 2010 to April 2011, two camera traps were placed near each of two lemur groups' sleeping sites. A total of 1067 unique lemur photos resulted, and 451 of these photos were after dark. Using the number of nighttime photos

as a proxy for activity levels, no significant differences were found between the two lemur groups. Nighttime lemur activity increased with cool nighttime mean monthly temperatures ($R^2=0.604$, $p=0.040$). However, neither correlation nor linear regression could explain variation between nighttime activity and mean monthly day length, temperature maximum, rainfall (or phenological abundance), and nightly moon illumination. These data were unexpected given that increased nocturnal activity with cool nightly temperatures has not been previously reported. Furthermore, in other lemur species, increased nocturnality is coupled with increased moon illumination, yet no such association was found here. Though further research is required to fully understand the proximate factors of nocturnal activity in *L. catta*, this species should be considered cathemeral, rather than strictly diurnal.

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Biomechanical relationships between chewing efficiency and dental morphology in modern humans.

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The functional relationships between mastication and craniodental morphology have primarily been studied by examining bite force in relation to chewing efficiency and dental morphology. However, relatively little is known about the relationship between dental morphology and chewing efficiency. This study examined how aspects of dental morphology affect efficiency during mastication by measuring this relationship in healthy human adults. The slope, volume, and relief of each subject's right first and second upper and lower molars were calculated in ArcGIS using three-dimensionally scanned dental casts. Participants completed a series of trials in which five almonds were chewed for 10, 20, and 30 seconds and 10, 20, and 30 masticatory cycles; chewing efficiency was calculated for each trial using particle size. High speed motion capture and electromyography were used to estimate the mechanical work performed while chewing. As expected, particle size decreased as chewing work (cycles or mechanical work) increased. We discuss the relative contributions of dental morphology and mechanical work to chewing performance across subjects, as well as potential application to the hominin fossil record.

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Neandertal paleogenomics and the origins of language.

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The development of human speech involved complex cerebral and genetic changes during hominin evolution, as well as a precise sensory-motor coordination. One gene, FOXP2, is known to play a key role in language, since its inactivation in some humans produces problems with grammar and language comprehension, but also in correct fine mouth movements. FOXP2 is a transcription factor (e.g., a gene that activates the expression of about one hundred other genes), and likely plays a crucial role in the neuronal organisation associated to oro-facial movements. Despite being among the most conserved genes in mammals, the FOXP2 differs from that of great apes by two amino-acid changes, mutations that likely took place in the last few hundreds of thousands of years during hominin evolution. The retrieval of these positions in Neandertals from El Sidrón (Spain) and Vindija (Croatia) showed they shared with us the same gene version and thus, likely had similar language capabilities. Future research would focus on possible modifications of regulatory regions near the FOXP2 in modern humans and also in the functional analysis of other potential genes related not only to language, but also to brain organisation.

Nutritional and energetic correlates of cheek pouch use in Cercopithecinae: implications for interpreting the role of feeding competition in the selection of diet-related morphology and food processing behavior.

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Cheek pouches are found ubiquitously among Cercopithecinae species. Unlike other mammals exhibiting this trait (e.g., Rodentia), cercopithecines feed gregariously, suggesting potential for feeding competition as an important selective pressure on this trait. Earlier work (Lambert 2005) demonstrated that *Lophocebus albigena* and *Cercopithecus ascanius* in Kibale National Park, Uganda, are more likely to use cheek pouches when consuming fruit, when distance among feeding animals is low (<5m), and with increasing density of feeding neighbors. Here we test the hypothesis that if cheek pouches increase feeding efficiency by reducing competition over contestable foods, then foods higher in energetic or nutrient density are more likely to be cheek-pouched than lower-quality foods. To test this hypothesis, we used standard nutritional methods and near infrared reflectance spectroscopy to measure fat, total non-structural carbohydrates (TNC), crude protein (CP), and neutral detergent fiber (NDF) of foods cheek-pouched by *L. albigena* and *C. ascanius* ($n = 19$) versus immediately swallowed foods ($n = 18$). Total energy (TE) and non-protein energy (NPE) were calculated with no assumptions of energy yielded from fermentation. Results indicate that the average fat, TNC, CP, and NDF of cheek-pouched foods are 10.2, 39.1, 26.0, 38.5, and non-cheek pouched foods are 11.7, 38.9, 26.6, and 41.5, respectively (% dry matter basis). TE and NPE of cheek-pouched foods were higher (412.0, 307.8) than in non-cheek pouched foods (392.9, 286.5). These data suggest that nutrient

density influences oral processing behavior and may shed light on the natural selection of morphology related to competition over contestable foods.

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Trauma in cross-cultural perspective: a comparative bioarchaeological study of prehistoric trauma in the Americas.

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Trauma patterns in human skeletal remains provide an empirical basis for analyzing the physical risks associated with different geographic regions, subsistence strategies, political systems, and settlement characteristics. They can also reveal important cultural information about age and gender roles as these are reflected in accidental and intentional injury patterns, and insights into the role of culture in shaping violent conflict and its osteological manifestations. Pursuing this line of inquiry, this paper compares trauma patterns in human skeletal remains from four prehistoric regions of the Americas: California, the Four Corners region, the Southeast (North Carolina/Virginia), and north coastal Peru (Moche Valley). These comparisons reveal both striking similarities and profound differences in trauma patterns across the four regions, findings of relevance to theoretical inquiries related to risk management and to models of warfare causation.

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Understanding early human demography variation and Mt haplogroup distribution in the Americas.

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The *tempo* and *mode* of the initial human dispersal in the Americas is a key issue for the study of its ulterior variation and diversity through time. We present a demographic model to explore the population dynamic on the base of paleo-environmental reconstructions between the ca. 18 and 10 kybp and different dispersal simulations are presented by considering a fast invasive process and a slow one. The model used Fisher equation plus a term related to carrying capacity; when population density achieved certain threshold, it has to move to the best neighbor environment. Our population dispersal model depends on population growth, diffusion and a minimum population to produce a migration. The equation considers gender differences in the populations and also estimates the reproduction probability for men and women.

The results show a relatively similar demographic distribution in both cases, where Mesoamerica and the Amazon were areas with higher population densities since early moments. We consider Mt haplogroups inheritance in the models and its shows a very similar distribution

with the actual ancient DNA available data. It seems that Mt haplogroups distribution is probably related to major bottleneck effects during the initial population dispersal in North and South America. The simulations also reveal that a high average annual population growth could be necessary to explain the Americas colonization by a single population spreading from Beringia to Tierra del Fuego. The models show diverse scenarios useful for highlight different aspects of the Pre Clovis-Clovis debate. The evolutionary consequences are discussed.

Development of bone strength and rigidity at Neolithic Catalhoyuk: adaptation and lifestyle in early Holocene farmers from south-central Anatolia.

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The shift from foraging to farming and the rise of large, agglomerated communities in the earlier Holocene occasioned profound changes in lifestyle and activity. This study documents and interprets a unique record of activity and lifestyle in a large series of human remains from Catalhoyuk, an early Neolithic community in south-central Turkey dating ca. 9400-8000 yBP, focusing on developmental changes and patterns for bone strength (Z_p , polar section modulus, standardized for body size) of femoral midshafts (50% section) for juveniles (neonate to 21; n=35) and adults (n=61; 30 males, 31 females). Analysis of Z_p reveals strong similarity in growth trajectory with a comparable series from the northern Great Plains (Sully site, South Dakota). The ontogenetic pattern suggests an active environment and adequate nutrition. Comparisons of Catalhoyuk adult Z_p with European Early and Late Upper Paleolithic, Mesolithic, other Neolithic, and Bronze Age series shows that Catalhoyuk males are closest to Upper Paleolithic and Mesolithic (hunter-gatherers) series, whereas adult females are similar to other Neolithic series (farmers/pastoralists). Comparisons of A-P/M-L bending strength place both adult females and males from Catalhoyuk closest to other Neolithic (sedentary) samples. These results suggest that the population led a highly demanding, yet sedentary lifestyle. Over the course of the history of the community, there is some suggestion of increased mobility, at least among females, coinciding with increased aridity and depletion of resources prior to the abandonment of the community.

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GPA, TW2RUS, TW3RUS and FELS – a comparative study on bone-age of the left hand and wrist.

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The Atlas-method of Greulich and Pyle (GPA) is widely used for forensic age estimations based on hand-wrist radiographs. The Tanner Whitehouse (TW2RUS, TW3RUS) and Fels methods (FELS) are two other well-known methods. The aim of this study was to investigate bone-age assessment on two samples of hand-wrist radiographs of different ethnic origin. To our knowledge, this is the first comparative study on GPA, TW2RUS, TW3RUS and FELS methods. A total of 174 hand-wrist radiographs from young Danes (12-20 years) and young asylum seekers of mixed ethnic origin (chronological age unknown) were blindly assessed by all methods by two of the authors. Reproducibility was least with the GPA method. TW2RUS had the highest accuracy for boys. FELS had the highest accuracy for girls. Between the three methods bone-age assessments could differ up to three years. Differences among methods were unaffected by ethnic origin. In conclusion, the practical consequences of the choice of method should be kept in mind when performing forensic age estimation. Because relevant information on accuracy of methods can rarely be obtained, the use of more than one method for bone-age assessment should be considered.

An oral health assessment of coastal and inland early and middle Neolithic south China and Taiwan.

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Previous studies of prehistoric health in Southeast Asia find skeletal samples at the transition to agriculture do not follow the same pattern of decline as seen in other areas of the world. This paper examines the oral health of early and middle Neolithic groups (7000-4500 BP) from riverine and coastal environments of south China and Taiwan, a region considered part of Southeast Asia. Using several indicators of oral/dental health and lifestyle (dental caries, antemortem tooth loss-AMTL, alveolar defects, dental calculus, and dental attrition) this study examines the biocultural implications of subsistence changes from the early to middle Neolithic in coastal and inland riverine environments of southeast China. Skeletal assemblages investigated include Dingshihshan culture, Guangxi (c. 6000 years BP), Hemudu culture, Zhejiang (c. 6000 years BP), Tanshihan culture, Fujian (c. 4500 years BP) and Nankuanli East (NKLE), Tainan County, Taiwan (c. 5000 years BP). The hypothesis tested is that higher frequencies of stress will be observed in the middle Neolithic samples and in samples that may be more reliant on agriculture such as the inland riverine sample of Dingshihshan. Oral health profiles suggest these samples follow the same general patterns as Southeast Asian samples. Low levels of caries, infectious disease, and AMTL suggest these groups were relatively healthy but inland samples with restricted

resources and middle Neolithic samples more reliant on agriculture are subject to higher stress. Inland samples have lower levels of AMTL than coastal samples and higher levels of wear and calculus suggesting different subsistence activities.

Model selection, zero-inflated models, and predictors of primate abundance in Cameroon.

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Determining the ecological and anthropogenic factors that shape the abundance and distribution of wild primates is a critical component of primate conservation research. Such research is complicated, however, whenever the species under study are encountered infrequently, a characteristic of many taxa that are threatened with extinction. Typically, the resulting data sets based on surveys of such species will have a high frequency of zero counts which makes it difficult to robustly determine the predictor variables that are associated with species presence or absence. In this study, we test various statistical models using survey data that was gathered on seven species of primate in Korup National Park, Cameroon. Predictor variables include hunting signs and aspects of habitat structure and floristic composition. Our statistical models include zero-inflated models that are tailored to deal with a high frequency of zero counts. First, using a stepwise regression procedure and Akaike's Information Criterion (AIC) corrected for small sample size, we found that models with up to five variables were most informative. Based on this analysis, we used five predictor variables to construct several regression models including Poisson, zero-inflated Poisson, negative binomial, and zero-inflated negative binomial. Results show that a zero-inflated negative binomial model outperformed all other models. We discuss the statistical logic behind zero-inflated models and we recommend that researchers explore a variety of models when determining the factors that correlate with primate abundance. In particular, the often-used Poisson regression model can provide misleading results that can have negative implications for conserving threatened primate species.

Anterior tooth root morphology in Neanderthals and anatomically modern humans: quantification and functional implications.

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Neanderthals incisors and canines have been described as long-rooted and this has been

used to taxonomically differentiate Neanderthals from modern humans (MH). The anterior dental loading hypothesis (ADLH) explains this difference as an adaptive response in Neanderthals to higher or more frequent loads on the anterior dentition.

This research tests whether a broader set of anterior root dimensions (length, surface area, total volume, pulp volume and cervical area) can distinguish Neanderthals from MH. We used high resolution micro-computed tomography (~27µm) to access the root morphology of *in situ* and isolated teeth, and internal dental tissue proportions. Our samples comprise maxillary and mandibular permanent incisors and canines from Neanderthals (N=96), recent MH (N=152) and early MH (EAMH, N= 9). Isolated specimens were also included in the analysis: Mauer (Middle Pleistocene), Oberkassel (Magdalenian) and Combe-Capelle (Mesolithic). Mann-Whitney-U tests performed on the root variables indicate that Neanderthals display significantly larger values than recent MH for all the measured parameters in anterior dentition ($p < 0.01$). Mauer falls close to the means of the Neanderthals and EAMH within the lower range of the Neanderthal variation. Our results demonstrate the strength of these metrics to distinguish Neanderthals from recent modern humans. However, the distributions of the two groups overlap and taxonomic attribution of isolated teeth cannot be based solely on root metrics. The ADLH hypothesis cannot be rejected and the larger root surface areas in Neanderthals may have been an adaptation to high loads on the anterior dentition.

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Diet and food availability of Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) in Khau Ca area of Ha Giang Province, Vietnam.

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We studied the diet and food availability of Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) for 18 months (from December 2004 to May 2006) in Khau Ca area of Ha Giang Province, Vietnam. This species uses 32 plant species. Its dietary composition includes leaf petioles, ripe and unripe fruits, young leaves, flowers, and seeds. Reflecting seasonal changes of the Khau Ca forest, Tonkin snub-nosed monkeys eat more young leaves and flowers in the period of March to May and more fruits in August to October. Among four botanical one-km transects, 385 trees (34.90%) occupied 44.20% of total basal area and 16 species (10.47%) are used by the Tonkin snub-nosed monkeys. Some food plant species including *Excentrodendron tonkinense* (Tiliaceae), *Garcinia* spp. (Clusiaceae), *Olea* spp. (Oleaceae), *Diospyros* spp. (Ebenaceae) and *Iodes seguinii* (Icacinaeae) dominate the Khau Ca forest. Although the Khau Ca area contains the largest and only viable population of Tonkin snub-nosed monkeys with a population of just over 100 individuals, only 700 ha of less 1,000

ha Khau Ca forest is suitable habitat for the monkeys. Thus forest rehabilitation and expansion programs are needed to increase the available habitat for Tonkin snub-nosed monkeys in Khau Ca.

Are bound feet an expression of Chinese ethnic identity during the Manchurian-ruled Qing Dynasty (1644-1911)?

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Two hundred and three burials were analyzed from the Xuecun archaeological site, Henan Province, China. The burials were salvaged from a water diversion project from the Yangtze River to Beijing. The burials dated from the Han Dynasty to Qing Dynasty (206 BC-1911 AD). This population sample provided a unique opportunity to analyze the practice of foot binding in central China. Length and width metatarsal measurements were taken from 11 individuals with bound and 9 individuals with unbound feet. T-tests showed a significant difference in the length of all metatarsals between bound and unbound feet. The largest difference was noted in the metatarsal4 and metatarsal5 length. T-tests also showed a significant difference in metatarsal width between bound and unbound feet. The most extreme reduction in width was found in metatarsal5. Individuals with bound feet consistently showed atrophy of the musculature of the legs. Several individuals also had broken arms and ribs possibly due to falls. No instances of foot binding were found from the Han Dynasty to the Song Dynasty (206 BC-1276 AD). Thirty-three percent of the women from the Chinese-ruled Ming Dynasty (1386-1644) had bound feet. By the Manchurian-ruled Qing Dynasty (1644-1911) 100% of the women had bound feet. This dramatic increase in foot binding may have been a symbol of Chinese ethnic identity and rebellion in response to the sumptuary laws of the Manchurian ruling elite.

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An ancient DNA perspective on the Iron Age "princely burials" from Baden-Württemberg, Germany.

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During the Iron Age in Europe, fundamental social principles such as age, gender, status, and kinship were thought to have played an important role in the social structure of Late Hallstatt and Early Latène societies. In order to address the question of kinship relations

represented in the Iron Age "princely burials" that are characterized by their rich material culture, we carried out genetic analysis of individuals associated with the Late Hallstatt culture from Baden-Württemberg, Germany. Bone specimens of thirty-eight skeletal remains were collected from five sites including Asperg Grafenbühl, Mühlacker Heidenwäldle, Hirschlanden, Ludwigsburg, and Schodeingen. Specimens were subjected to DNA extraction and amplification under strict criteria for ancient DNA analysis. We successfully obtained mitochondrial DNA (mtDNA) control region sequences from seventeen individuals that showed different haplotypes, which were assigned to nine haplogroups including haplogroups H, I, K, U5, U7, W, and X2b. Despite the lack of information from nuclear DNA to infer familial relations, information from the mtDNA suggests an intriguing genetic composition of the Late Hallstatt burials. In particular, twelve distinct haplotypes from Asperg Grafenbühl suggest a heterogeneous composition of maternal lineages represented in the "princely burials". The results from this study provide clues to the social structure reflected in the burial patterns of the Late Hallstatt culture and implications on the genetic landscape during the Iron Age in Europe.

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Reproductive energetics in primates: how costly are babies?

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Our recent studies of infant captive baboons (Garcia et al. 2008; 2009) found that infant to maternal mass was positively associated with reproductive parameters, e.g., duration of postpartum amenorrhea and interbirth interval. Baboon mothers resumed cycling and reconceived when their infants attained a relatively consistent threshold mass, as predicted from interspecific life history theory. We suggested that the duration of investment acted as a facultative adjustment to infant growth rates, and depended on maternal physical and social characteristics, such as size and dominance rank. What was surprising was the relatively low energetic cost associated with reproduction; mothers' intake and energy expenditure measured by the DLW method (Rosetta et al. 2011) did not closely predict the time to resumption of cycling. Energy expenditure was correlated with maternal body mass both during early lactation and after the resumption of cycling and there was a relationship between maternal energy expenditure and infant growth rates; mothers with rapidly growing infants had higher energy expenditure than did those with slowly growing infants. Here we place these results on infant growth and reproductive energetics into a broader primate life history perspective, and explore the question of how costly are non-human primate infants? I partition expenses into time costs and energy costs and

look at each of these over the early phase of growth, using the baboon model.

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Salkhit and modern human origins in northeast Asia.

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The early modern human fossil discovered in Salkhit, Mongolia, is considered to be of late Pleistocene based on biostratigraphy, and an important addition to understanding modern human origins and evolution in northeast Asia. Previous study associated Salkhit with archaic humans using metric and non-metric variables; however, subsequent discussions have associated Salkhit with modern humans ancestral to the first peoples of Americas. The recent replacement model for modern human origins predicts that Salkhit is a different species from archaic northeast Asians. In this paper, we ask if the amount of variation in the fossil sample of archaic and modern humans in northeast Asia is too much to be from a single species.

The fragmentary nature of the fossil data imposes methodological limitations to using traditional statistical methods. We use an alternative approach, STET, a method using the standard error of the coefficient from a linear regression model relating a pair of specimens. Using STET, Salkhit is compared with early moderns in Africa, in northeast Asia, and archaic humans in northeast Asia. Preliminary results fail to reject the null hypothesis that Salkhit and other moderns belong to the same species as the archaic humans in northeast Asia. Our findings do not support the hypothesis of modern humans as a new, recent species.

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Sex-related patterns of dentoalveolar abscesses in the genus *Pan*.

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Dental abscesses may be used as an indicator of dental health in non-human primates. These lesions may result from traumatic injury to the dentition, high rates of attrition, or extensive crown destruction from carious lesions. Interestingly, abscesses seem to be more frequent among great apes than other primates, particularly associated with the canine (Schultz 1956). To date, few studies have explored differences between males and females for dental abscess formation among great apes. Potential factors that may be related to the occurrence of dental abscesses in great apes include canine size and rates of attrition, but little information exists for overall patterns of occurrence within species. The current study aims to clarify the picture of dental health for males and females of two species of chimpanzee, *Pan troglodytes* and *Pan paniscus*. Visual observations were made of

mandibles and maxillae of 407 chimpanzees, 295 *Pan troglodytes* and 112 *Pan paniscus*, from collections at the Royal Museum for Central Africa, Tervuren, Belgium and the Powell-Cotton Museum, Birchington, UK. Abscess frequencies were calculated for adult males (*P. troglodytes* 28.1%, *P. paniscus* 33.3%), females (*P. troglodytes* 25.5%, *P. paniscus* 17.9%), and subadults (*P. troglodytes* 5.7%, *P. paniscus* 7.5%). The only significant difference in the frequency of occurrence was between adults and juveniles. This finding supports previous research of increased numbers of dental pathologies with increasing age. It also suggests that males and females are subjected to the same risk factors for dental abscesses, potentially ruling out some causal factors related to sexual dimorphism.

Using mammalian microfauna to reconstruct Hominin paleohabitats in South Africa.

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Fossilized faunal remains have long been used to infer paleoenvironmental conditions at hominin-bearing localities, but mammalian microfauna have been underutilized despite their abundance in the fossil record. One difficulty in using micromammals to reconstruct past environments is that the specific habitat and dietary affinities of many modern species remain unresolved. The diets and habitats of micromammal species can also vary significantly from region to region.

This study refines our understanding of micromammal ecology within the Cradle of Humankind World Heritage Site, South Africa. We anticipated that certain microhabitat types would be characterized by unique small mammal community structures and that habitat and dietary generalists would have highly variable diets. We assessed small mammal community structure using samples collected from accumulated pellets at roost sites of the African Barn Owl (*Tyto alba*) and trap lines. Roost and trapping sites were located within different microhabitat types ranging from open grassland to closed, wooded areas. In addition, stable isotope analyses were conducted on hair and tooth enamel samples to investigate diet.

Our results indicate that despite their relative proximity, microhabitats are characterized by distinct differences in diversity and relative abundance of micromammal species. Furthermore, we find that isotopic values, while variable in generalist species, are highly variable even in many species with purportedly narrow habitat and dietary preferences. We discuss the implications of these findings for paleohabitat reconstruction generally and provide preliminary assessments of the Sterkfontein, Swartkrans, and Gladysvale micromammal assemblages.

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Phylogenetic analysis of facial orientation in modern *Homo sapiens* and *Pan troglodytes*.

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Modern humans have been reported to be unique among the hominoids in having strongly ventrally deflected midfaces when palate orientation is measured relative to the posterior cranial base (PCB). The current study considers facial orientation in a phylogenetic context and relative to multiple registration planes to test whether hyper-ventral palate flexion is a derived feature of modern *H. sapiens* to the exclusion of *Pan*, the sister group to the Hominina.

Midfacial orientation was quantified on lateral radiographs of modern *Homo sapiens* (n=80) and *Pan troglodytes* (n=53) by measuring angles formed between the palate and four reference planes: a perpendicular to the orbital axis (POA); a perpendicular to the Frankfurt horizontal (PFH); the posterior maxillary (PM) plane; and, the PCB. Raw, interspecific adult mean angular values of *Homo* and *Pan* were contrasted using one-tailed *t* tests. *Homo* angle means were further compared to the other hominoid genera.

In palate orientation measurements made relative to the POA, PFH, and PM planes, *Homo* did not have more ventral midfacial angles than *Pan*. In fact, *Homo* demonstrated relatively dorsal values for palate orientation that approached the hylobatid condition. Relative to the PCB registration plane, *Homo* was markedly derived from *Pan* and other hominoids with a highly ventral palate orientation. These results suggest earlier findings of ventral facial orientation in *Homo* may have been unduly influenced by the relatively flexed orientation of the PCB in *Homo*. Implications for the homology of facial orientation and for evaluating various evolutionary scenarios of hominoid evolution are discussed.

Termites and bone tools: implications of termite genera on the foraging behavior of the Swartkrans hominins.

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Evidence of South African hominin termite foraging has been reported based on analyses of wear patterns on the ends of bone tools from sites in the Sterkfontein valley. This conclusion has been credited by some to be a plausible explanation for unexpected carbon isotope signatures present in South African hominin teeth that suggest the diet was different from that of extant non-human great apes. Grass-eating termites such as the genus *Trinervitermes* are one potential resource that could contribute to the carbon signature. However, not all termites forage for grasses, and in fact, *Macrotermes*, the termites most widely consumed by chimpanzees and by many present-day human populations, almost exclusively forage on the remains of

woody plants, and therefore would not contribute to the signature.

This study reviews evidence gathered from the bone tool assemblages and addresses the desirability and nutritional value of termites likely present on the Plio-Pleistocene South African savanna. Wear pattern analyses on tools used to dig mounds constructed by different termite genera were inconclusive, and the best support for which termites would have been consumed comes from behavioral and ethnographic data. Termites of the genus *Macrotermes* may be the most likely resource for hominins since they are highly selected by both chimpanzees and humans. These termites would not contribute to the surprising carbon isotope signature, but if both the soldiers and alates were being consumed, they would provide a reliable source of protein and fat, which are valuable for larger-brained hominins navigating the South African savanna.

A quantitative assessment of body perception: Elliptic Fourier Descriptors.

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The phrase “body image” or “body perception” refers to how individuals perceive their own body. Body perception studies are either largely descriptive in character or based on indirect measures such as height, weight, BMI, etc.,. Quantitative assessments of total body images have been rarely attempted because of the lack of available methods. This study compared whole body photographs of a non-clinical population (n=132) of Japanese women with a line drawing prepared from memory to assess their self-perception. A test-retest procedure, two-weeks apart (n=21), tested the reliability of the drawing procedure ($r = 0.81 \pm 0.05$, $p < 0.01$) and was found reliable. Elliptical Fourier analysis (EFF) was used to describe the shape of the outline of both datasets: the frontal view photograph and its drawing. Utilizing 108 digitized points, a size-standardized EFF with 54 harmonics was generated. A set of 23 distances was then computed from the EFF. Superimposition of photograph and drawing for visual purposes was implemented using Procrustes to insure a minimum shape difference. Statistical comparisons (MANOVA), of the sample of photographs with their drawings displayed significant results (F-tests, $p < 0.001$) for representative body measures such as *hip width*, *thigh width*, and left and right *calf widths*. These measures displayed smaller values for the drawing compared with the photograph and suggest that young Japanese females, as their western culture counterparts, unconsciously favor slimness as a desirable body image. With respect to studies of body shape and its perception, EFFs were found to be useful and could generate reference data for future studies.

A comparison of hunting and butcher knife trauma on semifleshed and unfleshed pig bones.

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The goal of this study was to quantitatively assess incisions left by a hunting knife and a butcher knife on semifleshed and unfleshed pig femora. Previous studies have shown that serrated blades leave significantly different incision marks on bone than non-serrated blades, however, there is a lack of quantitative data on the differences between tool marks left by non-serrated blades.

We hypothesized that a hunting knife would leave wider incisions than a butcher knife due to its wider blade. We also predicted that trauma to unfleshed bones would produce wider incisions than trauma to fleshed bones.

To test these hypotheses, we made two incisions on each semifleshed (n=12) and unfleshed (n=16) pig femur using either a hunting knife or a butcher knife, then removed the remaining tissue and dried the bones. We photographed and measured each incision under a dissecting microscope and made molds of the incisions using silicone casting material. We used landmark analysis to compare the incision shape and wound pattern. Our results show that there are significant differences between the incisions left by the two knives; the butcher knife left narrower incisions with significant crushing present, while the hunting knife left wider incisions with minimal crushing, and large exit chips.

Our results suggest that it is possible to differentiate between incisions left by different non-serrated blades. These findings can be applied to both forensic trauma analysis as well as analysis of trauma in archaeological contexts.

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Dark days: the 1907 epidemic on Inishark, Co. Galway, Ireland.

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Modeling infectious disease in a 19th/20th century island community requires an understanding of the biotic and abiotic environment. In this paper we present a case study from the remote island of Inishark, Co. Galway, Ireland, in which we develop a quantitative and qualitative framework of community epidemiology. Located 8 miles from the mainland, the village of Inishark provides a unique case study of key factors in epidemiological dynamics. In May of 1907 an epidemic, now believed to be typhus, occurred on Inishark. Analysis of census and daily school records from 1907 indicate that of a pediatric population of 50 the epidemic had an incidence rate of 22.4%, a case fatality rate (CFR) of 21.4%, and a mortality rate of 12.0%. School

records indicate the principal outbreak lasted for 2.5 weeks and resulted in 6 pediatric deaths. While still poorly understood, this mortality rate is not seen in adult population. Ethnographic accounts, newspaper records and oral histories, indicate that island life was based on a dual piscatorial and agrarian economy that resulted in seasonal, highly variable, and at times unpredictable pattern of resource availability. December to April nutritional deficiencies overlapped with the period when islanders spend the highest amounts of time inside due to cold temperatures, rain and limited sunlight. Moreover, island homes were a nexus of pathogens and human hosts. Consideration of these factors allow for accurate understanding of 19th / 20th century island epidemiological dynamics in general, and modeling of the Inishark 1907 epidemic in specific.

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Genome-wide markers and the peopling of South America.

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Initial inferences of the peopling of South America from molecular genetic data were dependent on a handful of classical genetic markers and/or markers with uniparental inheritance (mitochondrial and Y chromosome). These studies supported a clear picture for the peopling of South America from single North American gene pool, and this picture has remained robust by subsequent molecular studies. However, the characterization of hundreds of independently evolving loci, such as that provided by genome-wide marker studies, provided an unprecedented level of information for modeling and inferring the last great continental expansion of our species. In this presentation, we present the current state of genomics and its contribution inferring the number and path of the initial migrations into the Americas as well as the impact of subsequent population dynamics, including global admixture.

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Demographic and social influences on ectoparasite transmission in wild Verreaux's sifaka (*Propithecus verreauxi*).

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Host sociality is an important predictor of parasite risk because parasite transmission can increase when host individuals spend more time in contact with conspecifics. Group size and

association patterns have been shown to influence parasite loads by affecting the frequency of intraspecific contacts. We examined the relationship between within-group social patterns and ectoparasite dynamics in Verreaux's sifaka (*Propithecus verreauxi*), a gregarious folivore, in the Kirindy Mitea National Park of Madagascar. Ectoparasite counts (e.g., lice, *Trichophyloterus babakotus*) were collected opportunistically for 32 individuals during annual captures between 2006 and 2010. Over 1300 hours of contact and grooming data were collected using focal animal sampling for 20 individuals from January 2007 to December 2008. We used these data to assess the influence of demography and social behavior on ectoparasite loads for Verreaux's sifaka in five social groups (range=3-11 individuals). Ectoparasite load was positively correlated with social group size. Males, in general, had higher ectoparasite counts than females. The number of within-group contacts exhibited a significant positive relationship with ectoparasite loads, but only for females. Ectoparasite loads, however, were not correlated with the rate at which sifaka received grooming. Before and after data were available for three males who transferred social groups and all three males had higher ectoparasite loads after dispersing. Sex differences in sifaka ectoparasite loads most likely arise from behavioral patterns, such as female dominance and male-biased dispersal. Our results suggest that contact networks influence ectoparasite transmission in Verreaux's sifaka.

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The effect of biacetabular breadth on metabolic cost of human walking and running.

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The assumption that biacetabular breadth (BAB) relative to leg length affects the cost of bipedal locomotion has led to the inference that *Australopithecus* and *Homo* differed in how efficiently they walked. Although previous work has examined the relationship between pelvic width and mechanical advantage of the lesser gluteal muscles using static mechanical models, few studies have experimentally tested the effects of BAB and muscle mechanical advantage on metabolic cost of different gaits. We collected data on oxygen consumption during bipedal walking and running in a mixed-sex sample of fit human subjects. Kinematic data were also collected using reflective markers placed on relevant pelvic and femoral landmarks and a three-dimensional infrared motion capture system. BAB was estimated from the known relationship among pelvic bony landmarks, and scaled by hindlimb length. Lesser gluteal mechanical advantage was calculated from interlandmark distances. Multiple regressions indicated no significant relationship between muscle mechanical advantage and cost of transport during both walking and running. Furthermore, at both slow and fast walking speeds, the relationship between relative BAB

and metabolic cost was weak ($R^2 \leq 0.16$). However, during running, there was a strong positive linear relationship between relative BAB and metabolic cost of transport ($R^2 = 0.69$). These results suggest that relatively widely spaced acetabulae was not a major cost for *Australopithecus* and that decreased biacetabular breadth in the genus *Homo* improved running economy. BAB, however, is only one of many measures of pelvic width, and we discuss its relationship to other aspects of hip and pelvic width.

This work was supported by funding from the American School of Prehistoric Research and the Hintze Family Charitable Foundation.

Odontological characteristics of the craniological series from the Bol'shoi Olen'ii island in Barents Sea: new data on Eastern impulse in Saami ethnogenesis.

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Field seasons 2001-2004 of the Cola archeological expedition resulted in obtaining new odontological data on the people, who occupied the Cola peninsula and were buried at Bol'shoi Olen'ii Island (1000-1500 B.C.). The main goals of our investigations were: 1) to determine a historical position of these people among ancient population of Eastern Europe, 2) to define their role in ethnogenesis of Saami – the most investigated and still the most mysterious people of Europe.

We measured and described remains of 27 individuals. Obtained data testifies that the Eastern branch features prevail in the odontological complex of series and shows that the people of Bol'shoi Olen'ii Island belong to maturised types. This combination is most typical for North-Eastern relic odontological type, which exists in odontological types of contemporary Karelians, Veps and some groups of Finns of Finland while Saami and Komi considered as classic representatives of this type.

The existence of a reverse odontological trend («Eastern component») is more prominent at the Western margin of the arctic thus proving that the initial waves of Saami migration to the West were characterized by more considerable «Eastern component» than contemporary Saami population. But no paleoanthropological evidence for such migrations (Eastern impulse) has been obtained before. The results of our odontological investigations give such evidence and make it possible to conclude: the population that left the cemetery at the Bol'shoi Olen'ii Island in Barents Sea was characterized by the trait complex, which served as a basis for formation of odontological profile of contemporary Saami.

Genetic snapshot from ancient nomads of Xinjiang.

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Nomads of the Eurasian steppes are known to have played an important role in the transfer commodities and culture among East Asia, Central Asia, and Europe. However, the organization of nomadic societies and initial population genetic composition of nomads were still poorly understood because of few archaeological materials and written history.

In this study, the genetic snapshot of nomads was emerged by examining mitochondrial DNA and Y-chromosome DNA of 30 human remains from Heigouliang (HGL) site in the eastern of Xinjiang, which dated 2000 years ago and associated to the nomadic culture by archaeological studies. Mitochondrial DNA analysis showed that the HGL population included both East Eurasian haplogroups (A, C, D, G, F and Z) and West Eurasian haplogroups (H, K, J, M5 and H). The component of Eastern haplogroups is dominant. The distribution frequency and *Fst* values of Eastern haplogroups indicated the HGL population presented close genetic affinity to the nearby region modern populations of Gansu and Qinghai, while those of western haplogroups showed similar with Mongolia and Siberia populations. The results implied various maternal lineages were introduced into the HGL population. Regarding the Y chromosomal DNA analysis, nearly all samples belonged to haplogroup Q which is thought to be the mark of the Northern Asian nomads. We identified paternal kinship among three individuals at the same tomb by Y-STR marker.

Combined with archaeological and anthropological investigations, we inferred that the gene flow from the neighboring regions was possibly associated with the expansion of Xiongnu Empire.

Differences between black howler (*Alouatta pigra*) group size and pattern of vocalization in two ecologically different populations in northern Belize.

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Group size, adult sex ratio, and the duration, timing, and frequency of vocalizations of the black howler (*Alouatta pigra*) were studied at two sites in Belize, La Milpa and the Baboon Community Sanctuary. Semi-deciduous lowland broadleaf forest occurs at La Milpa, contrasting with a mosaic of riverine and dry forest near agricultural land at BCS. Howler population densities are much higher at BCS than La Milpa, and spider monkeys occur only at La Milpa. We expected to find smaller group size and a 1:1 sex ratio at La Milpa with fewer intergroup howling bouts.

Excluding lone males, average group size is 6.55 (range 3-11, n=9) at BCS, and 3.5 at La Milpa (range 3-5, n=4). At La Milpa the ratio of

females to males is 1:1, whereas it is 1.95:1 at BCS, an increase from the 1.3:1 ratio observed at the site from 1985-2001. Large group size at BCS may reflect both the difficulty young adult males have in establishing new groups (four lone males were seen at BCS compared to one at La Milpa), as well as an adaptation for successful intergroup defense.

Vocalizations at La Milpa primarily consisted of sunrise relays (5:50-6:30 AM) during which up to six groups were heard. Sunrise relays began even earlier at BCS, sometimes at 4:30 AM, and were of longer duration. Howling bouts resulting from intergroup encounters occurred at several times throughout the day and night at BCS indicative of the higher population density. Similar intergroup bouts rarely occurred at La Milpa.

Sheep in shoes: a new experimental test of Wolff's Law of trabecular orientation.

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Analyses of locomotor function often assume that trabecular bone modifies to line up its principle material axes with the trajectory of the principal loads within a joint. Wolff's so-called "law" of trabecular orientation, however, has not been tested experimentally in large mammals, and it is unclear how precisely or accurately one can predict peak load orientation in a joint from trabecular orientation. This question, moreover, cannot be answered using the comparative method, and requires controlled experimental testing. We tested the model using a sample of 20 sheep divided into three groups in which we varied tarsal but not carpal joint angles in two ways: (a) having some sheep run on inclined versus flat treadmills, and (b) having some sheep wear platform shoes on their forelimbs. Force plate analyses and kinematics were used to calculate an expected 3.6° difference in tarsal trabecular orientation, which was measured along with other parameters of trabecular bone architecture using microCT. As predicted, animals with more extended hindlimbs had 2.7- 4.3° ($p < 0.05$) less obliquely oriented trabeculae in the bones of the tarsal but not the carpal joint. In addition, sheep that were exercised had a significant increase in trabecular bone volume (BV/TV) and trabecular number (Tb.N) and a significant decrease in trabecular spacing (Tb.Sp). These results demonstrate for the first time in large mammals that trabecular bone responds in vivo to a change in loading direction by altering its principle material axes and realigning with the trajectory of the new principal loads within a joint.

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Lower limb activity in the Cis-Baikal: musculoskeletal stress markers among middle Holocene Siberian foragers.

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Lower limb musculoskeletal stress markers (MSM) are evaluated in order to reconstruct activity and more fully understand cultural and behavioral transition among the middle Holocene (ca. 9000-3000 years BP) foragers of Siberia's Cis-Baikal region. Five cemetery populations are examined, together spanning a period of dramatic diachronic change characterized by an 800-1000 year hiatus in the region's cultural continuity. Two of the cemetery samples represent the early Neolithic Kitoi culture, dating from 8000 to 7000/6800 cal. BP; the other three represent the late Neolithic-early Bronze Age Isakovo-Serovo-Glaskovo (ISG) cultural complex, dating from 6000/5800 to 4000 cal. BP. Findings suggest heterogeneity in overall lower limb use, but relative homogeneity in general activity patterns. Aggregate data reveal that Kitoi individuals and males engaged in more strenuous lower limb use than did ISG individuals and females, respectively. Furthermore, sexual disparity in MSM scores—being generally higher among males than females for both groups—appears to have increased with advancing age at death, emphasizing the influence of sex-related activities, rather than body size per se, on enthesal morphology. Rank patterning data, on the other hand, disclose remarkable similarities in the types of activities employed by the Kitoi and ISG alike. Hip extensors and abductors, pelvic and trunk stabilizers, and ankle plantarflexors and stabilizers all appear to have been heavily recruited, suggesting that activities such as walking and climbing, particularly while carrying heavy loads and traversing steep and uneven terrain, were frequently and/or intensively undertaken across the region.

The anatomy of an oil palm plantation and why African primate diversity is in trouble.

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Palm oil, the most widely produced vegetable oil, is derived from the oil palm (*Elaeis guineensis*). Oil palm plantations are developed in areas occupied by tropical forests, the most biodiverse of the Earth's terrestrial ecosystems and home to the majority of primate species. Due to the growing global demand for palm oil, agribusiness companies are increasingly seeking land leases in the African tropical forest zone. Little is known about the activities of these companies. The American-based Herakles Farms is planning a 70,000 hectare oil palm plantation in the heart of one of the most biodiverse and threatened ecosystems in Africa – the Cross-Sanaga forests along the Nigeria-Cameroon border. These ancestral

forests are home to some of the world's most threatened primate species, including the drill and Preuss's red colobus. We examine the Herakles Farms plantation plans in Cameroon to understand how such companies operate and to illustrate the challenges involved in preventing or influencing such developments. We consider evidence suggesting that Herakles Farms may have violated principles of the Roundtable on Sustainable Palm Oil (of which they are a member) and Cameroon law, ignored the protests of local opposition, and produced an inadequate environmental and social impact assessment. The proposed plantation will destroy primate habitat and could push to the brink of extinction already threatened primate populations in adjacent protected areas. This study will help conservation and development organizations better prepare for the influx of foreign agribusiness companies wishing to lease vast areas of tropical Africa over the coming decades.

Understanding historical and contemporary tuberculosis: the ties between TB and helminths in the Pacific.

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Syndemic theory allows for the identification and exploration of complex biocultural interactions between disease agents and the sociocultural conditions in which they operate. In this paper we identify the physiological interactions between tuberculosis and helminth infestation which occur both pre- and post-natally and track, through analysis of historical records, how these interactions have occurred in the context of colonial and postcolonial changes in the Pacific.

Specifically we analyse historical accounts of eradication campaigns as well as reports of TB prevalence from pre-World War II to 2000 in the nations of Tuvalu (then the Gilbert Islands) and the Cook Islands. We hypothesise that syndemic interactions between the two infectious conditions serve to explain aspects of the historical experience of tuberculosis for people in these Pacific nations, particularly the variable prevalence of TB on different islands of each group in the past, as well as the current highly varying rates between these two island groups – Tuvalu with one of the highest rates of tuberculosis among the Pacific Island Nations and Cook Islands with one of the lowest. The work emphasises how past colonial ecologies have long term legacies.

This work has been funded through a grant from the Health Research Council of New Zealand.

Refining dietary estimates at Machu Picchu using combined dental macro/microwear and isotopic analyses.

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Reconstructing diet in Andean populations is complicated not only by ecological complexity, but by large-scale population movements and trade networks during periods of imperial rule; this is most evident during the Inca-dominated Late Horizon period (AD 1438-1532). It is therefore more difficult to precisely reconstruct dietary patterns among populations within these contexts. Previous multi-isotopic analysis of the skeletal population from the Inca site of Machu Picchu in the southern central Peruvian Andes indicates marked variation in dietary composition both early and late in life. However, these data are limited in their specificity due to overlap in isotopic signals from different resource types; for example, maize, amaranth and marine proteins yield similar $\delta^{13}\text{C}$ values. This study compares existing carbon and nitrogen isotopic data to enamel macro- and microwear data to more accurately profile diet composition in a subset ($n=50$) of the Machu Picchu skeletal population. Preliminary results suggest marked variation in microwear patterns, and greater variation in dental microwear pit size and number than in scratches. While some individuals show no clear correlation between isotopes and overall dental wear patterns, there appears to be an inverse correlation in total number of pits and depleted $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values in others. Overall, these results suggest that some of the dietary variation at Machu Picchu may be tied to residential origin, represented by $\delta^{18}\text{O}$ values. They also reveal microwear-based subsets within similar $\delta^{13}\text{C}$ value ranges, which may prove useful in more accurately estimating consumed food resources in this and other Andean populations.

A comparison of permanent tooth formation in four African and two British groups.

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Little information on the timing of human permanent tooth formation in Africa is documented. The aim of this study was to compare mean age entering permanent mandibular tooth formation stages in four African and two British groups. Archived dental radiographs of 3548 female and 3085 male dental patients, aged 2-25 years of age were collected in Lagos, Nigeria, Khartoum, Sudan, Johannesburg and Pretoria, South Africa and London, UK. The formation stage of mandibular left teeth was assessed. Two key stages were analysed for these preliminary results: root one half (R1/2 when crown height=root length) and apex complete (Ac). Mean age entering these tooth stages was calculated using logistic regression with country and sex as explanatory factors and London Whites as the reference. Country of origin significantly affected mean age for all comparisons ($P<0.01$). Similarities in mean age were noted in the western and northern Sudanese groups as well as the White and Bangladeshi British groups. Mean age for many tooth stage comparisons were later in the two

Sudanese groups compared to other groups. Few young individuals from Nigeria and South Africa were available and early forming teeth could not be compared, however, both stages of third molars were significantly earlier in Nigerian and South Africans than other groups. These results suggest a complex pattern of permanent tooth formation within Africa.

Maternal origins of Accompong Maroons.

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The Accompong Maroons of western Jamaica have experienced a history marked with resistance, war, and geographic isolation. However, as a result of these historical events, there is some discrepancy regarding the ancestries of this community's first members. According to Maroon oral history, they are the descendants of Jamaica's indigenous population and escaped enslaved Africans. Other historians only acknowledge African ancestry as formative in this community.

To address the question of the biogeographic origins of Accompong Maroons, the maternal genetic ancestries of community members were examined. Fifty-one individuals with established genealogical ties to the Accompong Maroon community volunteered DNA that was genotyped for mitochondrial haplogroups. Each DNA sample was first screened at the 3592 HpaI restriction site, which is indicative of the most common mitochondrial haplogroup in Sub-Saharan Africa, macrohaplogroup L. If a sample did not belong to macrohaplogroup L, additional restriction sites were tested to identify the haplogroup. 80% of the samples were found to belong to haplogroups L1 and L2 while the remaining 20% belonged to L3 and other non-African mitochondrial haplogroups. Though additional samples and testing are needed, based on this preliminary study it appears that indigenous females either did not make a significant contribution to the contemporary Accompong community or that the resolution of mitochondrial DNA is not high enough to adequately detect possible ancestry. The results of this study provide a glimpse into the complex population history of the Accompong Maroons with a specific focus on the biogeographical ancestry of this community.

This project was funded with support from the Undergraduate Research Opportunity Program and the Balfour Heshburgh Scholars Program in conjunction with the Center for Undergraduate Scholarly Engagement at the University of Notre Dame. Additional support was received from an Annual Pilot Grant for Social Science Research from the Institute of Scholarship and Learning in the College of Arts and Letters at the University of Notre Dame.

Ancient Arkansas: skeletal remains from the Isgrig South site.

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In the fall of 2007, the Arkansas Archeological Survey began salvage excavations south of the Little Rock Airport in the Little Rock Industrial Park on the pre-Columbian archeological site of Isgrig South. This site yielded twenty grave features with co-mingled and poorly preserved human remains. The remains were carefully cleaned to recover as much of the deteriorated skeletal material as possible.

The salvaged skeletal material yielded a minimum of twenty individuals. From the reliably sexed individuals, three were determined to be female, and four male. The individuals within this assemblage ranged in age from young children (5 years +/- 16 mo), to adults (35+). Based on the representation of all ages and both sexes, this does not appear to have been an exclusive cemetery.

Dental lesions were noted in multiple individuals, including seven individuals which exhibited linear enamel hypoplasia, six individuals with caries, and one alveolar abscess. Skeletal lesions which may be attributed to osteomyelitis, porotic hyperostosis of the parietal, and hypervascularization of the maxilla, which may indicate scurvy were also observed.

Isgrig South is extremely important to our limited understanding of the confusing Late Prehistoric time periods (1300-1650 AD) in the Little Rock area. Though this collection of skeletal and dental remains is small and fragmentary, these findings indicate that this population suffered hardship and infection.

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Hands, laterality and language: hand morphology in the Sima de los Huesos site (Sierra de Atapuerca, Spain).

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The Sima de los Huesos (SH) site (Sierra de Atapuerca, Spain) has yielded a large collection of Middle Pleistocene human fossils that represent the ancestors of the Neandertals. These remains are around 500,000 years old and have been assigned to the species *Homo heidelbergensis*. Among the fossils recovered from the SH site are 518 hand bones, constituting the largest collection of hand bones for any fossil hominid site. We report here a preliminary description, metrics and comparison of the hand remains from SH. In particular, we

focus this work on traits related with manipulative capabilities and evidence for laterality in hand use: carpal bone morphology, development of the palmar tubercles, carpal tunnel dimensions, articulation between the trapezium and first metacarpal, thumb morphology and dimensions, finger length and phalangeal proportions, trochlea morphology and distal tuberosity expansion. The SH hand bones exhibit a number of primitive traits not present in Upper Pleistocene Neandertals. Other traits are close to the Neandertal morphology and some features show more variability than in Neandertals. Previous studies of the hearing capacities, endocast asymmetries and orientation of non-masticatory striations on the anterior teeth have suggested the presence of both language capacities and right-handedness in the SH fossils. The hand morphology of SH indicates a powerful power-grip and precision-grasping capabilities that are similar to what has been described on Neandertals and modern humans.

Geographic variation in hair $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of vervet monkeys (*Chlorocebus aethiops*) reflects anthropogenic impact.

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For many nonhuman primates, living amongst humans is a reality. Human-nonhuman primate sympatry frequently occurs among those nonhuman primates that are dietary generalists and largely terrestrial. In Africa, such relationships are often found among humans and cercopithecoids. Recently, the field of ethnoprimateology emerged to examine human-nonhuman primate interplays. Ethnoprimateologists use cultural anthropological and primatological methodologies in order to gain an understanding of these interconnections. As a result, many ethnoprimateological studies have explained human-nonhuman primate associations, largely in qualitative terms. By using stable carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope analysis we use quantitative data to understand the degree to which humans impact vervet monkey (*Chlorocebus aethiops*) dietary patterns and behavioral ecology. Hair was collected from 134 anesthetized animals hailing from 10 South African populations to study aspects of vervet monkey genomics, immunology, and phylogeography. Among these 10 locations, humans have modified vervet monkey habitats to varying degrees and the nature of human-vervet monkey interactions range greatly. The vervet monkey population at Woodhill (Pretoria) was regularly provisioned by the local people. In contrast, the Dronfield population was not observed eating human foods. The majority of vervet monkey populations we sampled consumed human foods when available. Those populations at Soetdoring, Baviaanskloof /Geelhoutbos, Parys, and the Gariep Dam used human foods to supplement their diets. This study demonstrates the utility of stable isotope analysis for understanding human-

nonhuman primate interconnections. This technique may be prove useful for primatologists interested in these associations, but lack the time or resources to employ the traditional long-term ethnoprimateological approach.

Ecological influences on primate maternal investment strategies.

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Relatively good data exist on primate maternal investment patterns (e.g., age at first birth, relative gestation length, neonate size, litter size, age at weaning, and weanling weight). All must be examined after controlling for adult female size, because size sets so much of the pace of life history. Some aspects appear to be largely phylogenetically determined, and as others have noted, family explains much of the variance. But ecological influences may influence variations within family. Here we examine variation in several maternal components, seeking ecological correlates. Preliminary analysis identifies a number of primates in which one or more maternal variables is a standard deviation or more from predicted values, and finds ecological correlates for some of these. We explore within-family variation in the three largest families (Cercopithecidae, Cebidae, and Callitrichidae). Finally, we examine variation within the Hominoidea, and find that human traits are less unusual than previously thought.

Associations between localized variation in brain anatomy and social behavior in healthy human subjects.

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Understanding the relationship between brain structure and function is critical for interpreting evolutionary changes in the human brain. It has been suggested that social environments play a key role in this process and brain size has been shown to correlate with social group size across primate species. Studies have indicated a disproportionate elaboration in areas of the prefrontal cortex in hominin evolution. The prefrontal cortex is known to be relevant to social processing, which suggests that selection for social ability may have played a significant role in prefrontal elaboration. Thus, in order for selection on social abilities to result in evolutionary changes in brain morphology, there must have been genetic correlations within modern humans between brain anatomy and social ability. To assess this possibility, associations between localized brain anatomy and several behavioral measures related to social facility were determined on a sample of 36 female sibling pairs (72 subjects total). Voxel-

based morphometric methods were used to quantify brain morphology in MRI scans, and self-reported degrees of social interaction/engagement were used as a proxy for sociality. A within-family analysis was used to control for possible confounding variables, such as socioeconomic status. Our results show both positive and negative associations distributed across various regions of the brain. There are suggestions of positive correlations in anteromedial prefrontal areas and negative correlations in areas of orbital frontal and anterior cingulate, though they are modest. Possible evolutionary and methodological explanations for these results will be discussed.

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Teeth and handedness of *Homo heidelbergensis* from Sima de los Huesos site (Sierra de Atapuerca, Spain).

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Handedness in living humans is well-established with a high degree of manual specialization on the right side. Some have attempted to document handedness, in the fossil record, but it remains unclear where and when in human evolution right-handedness appeared and became established in the modern 9:1 pattern.

Dental microwear analysis is a technique which provides information about the direction of action and handedness.

Our experimental work shows that these striations are the result of holding an object or materials between the anterior teeth and processing the items with a lithic tool. The orientation of the resulting cutmarks on dental enamel is different if the action was made by the right or left hand.

Analysis of striation patterns found on anterior teeth of *Homo heidelbergensis* sample from Sima de los Huesos (Sierra de Atapuerca, Spain) reveals a consistent pattern of handedness. These results clearly demonstrate that at least 500,000 years ago, the Sima de los Huesos population was already right-handed.

Ecosocial behaviour of Sierra de Atapuerca (Spain) hominids during Quaternary II. (Comportamiento ecosocial de los homínidos de la Sierra de Atapuerca durante el Cuaternario II). Ministerio de Ciencia e Innovación (CGL2009-12703-C03-02) Government of Spain.

A Vandenberg effect in wild geladas?

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In 1967, John Vandenberg conducted a series of remarkable experiments demonstrating that female mice mature significantly earlier when housed with an unrelated adult male as compared to being housed alone (Vandenberg 1967). This "Vandenberg effect" is thought to be one way that females can optimize the timing of maturation in response to environmental and social conditions. Intriguingly, a handful of cases from primate studies (including several from humans) offer tentative support for male-mediated maturation. However, whether female maturation is systematically accelerated by exposure to novel males remains untested in natural primate populations. Here, we investigated whether the onset of sexual maturation in wild female geladas (*Theropithecus gelada*) is sensitive to the social environment – particularly with respect to the arrival of unrelated males. Geladas are particularly relevant subjects for this research because gelada society features polygynous social groups (i.e., reproductive units) with frequent male replacement, and genetic data indicate that females mate exclusively with males in their unit. We examined the timing of all female maturations across 6 years of data from 21 distinct units. Our data indicate that the arrival of novel males triggers maturation for female geladas – a possible Vandenberg effect. Furthermore, young females residing in groups with unrelated males reached maturation at a younger age compared to those residing in groups with only their fathers. Taken together, these data suggest that the Vandenberg effect is a salient factor influencing sexual development in female geladas.

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Fundamental approaches to dental wear.

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Teeth need to grip, fracture, and fragment food particles without being damaged by wear. Though wear features are well-documented microscopically, many basic issues need to be resolved. These include why most wear features are so small and why scratches tend to outnumber pits. Our approach to this is two-fold. The first is based on the material properties of the interacting particles. We produced wear features on highly-polished surfaces of primate molars using particles mounted on a custom nanoindenter tip. We employed both static ('pit') and dynamic ('scratch') indentation modes, imaging them by AFM. Forces producing microscopic features were low milliNewton in range, agreeing with predictive equations. These forces are tiny compared to masticatory loads, so

why are larger features so rarely seen? One reason is the governing brittle-ductile transition (Lucas et al. 2008), but others specific to scratching include contact roughness and its effect on the frictional coefficient. The higher the coefficient, the lower the force to scratch, thus making scratches more likely features than pits. Physiological issues revolve around the need for lateral excursions in chewing, clearly implicated in the literature in scratch production. Reasons for this include the need to increase the probability of fracture of isodiametric food particles and the control of deformation in membrane-like foods.

Diet of the black howler monkey (*Alouatta pigra*) in mangrove forests and the phytochemistry of mangrove plants.

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I examined the diet of a population of black howler monkeys (*Alouatta pigra*) isolated on an island of mangrove forest on the Pantanos de Centla Biosphere Reserve in Tabasco, Mexico. It is unusual for large folivorous primates to inhabit solely mangrove due to low plant species diversity, many of which are specially adapted to saline conditions. Compared with lowland tropical forests, which can contain hundreds of species in a handful of hectares, plant diversity in American mangroves is limited to less than 15 species. Howlers selectively eat from an average of 60 species of plants over an annual basis to obtain adequate nutrients and avoid toxins. I hypothesized that the mangrove howlers may eat fewer leaves than other howler populations, exploit novel foods, and that food plants would reflect a high protein to fiber ratio. Through both wet and dry seasons, I collected data on the monkeys' daily activities and plant choices for food and non-food use. I assessed the phytochemical components of these plants and examined seasonal differences. The mangrove howlers used only 12 species for food. When compared to other howler populations, mangrove howlers ate significantly more flowers, more seeds, and less fruit. Leaf consumption was within the range of other howler diets. Protein to fiber ratios were slightly higher in plant products selected as food. An important seasonal difference was the availability of flowers and seeds, providing more protein and zinc to the howlers. The overall health of primate populations may not be limited by habitat diversity.

Meta-analyses reveal direction and timing of sex and gender differences in oral health.

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Understanding the direction, timing and causes of sex and gender differences in oral health are research objectives approached from different perspectives by anthropologists, epidemiologists and geneticists. This study uses a meta-analytic approach to assess the extent and timing of male-female differences in oral health

from data on caries and tooth loss in prehistoric and living populations. Two significant trends were initially identified: females tend to have higher caries rates than males and the increase in caries with age is greater in females than in males. These trends are consistent across diverse ethnic groups and subsistence systems. A meta-analysis of thirty-two independent reports of caries experience in South Asia, reveals higher caries rates more commonly among females than males. Data on caries prevalence and experience was gathered by gender for children and adults. Results show that: (a) in male children caries rates are greater than, or equal to, female rates, (b) the gender bias reverses ($F > M$ caries rates) from adolescence through the reproductive years, (c) mature adults typically exhibit significant differences, with higher caries rates in females, (d) a male gender bias in adults is rare, and (e) though some studies find no significant gender difference in caries, a female bias predominates. Tooth loss is also greater in women than men and results from caries rather than periodontal disease. Recent studies of oral health by sex in prehistoric samples shows greater appreciation for the impact female hormones and reproductive biology have on sex and gender differences in oral health.

Morphological diversity in the catarrhine pelvis: a comparative 3D geometric morphometric analysis.

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The primate pelvis plays an important role in studies of functional morphology; no more so than in the case of the catarrhines. With an increasing number of fossil hominin pelvic specimens being discovered, the importance of understanding taxonomic diversity within our infraorder has perhaps never been greater. However, pelvic morphology is difficult to assess via caliper measurements and traditional morphometric methods. Here, therefore, we used landmark data and adopted a 3 D geometric morphometric approach.

Our analyses included 2 males and 2 females for 30 extant taxa, representing 20 total genera. This includes 14 cercopithecoidea genera (13 Cercopithecinae species, 7 Colobinae species) and 6 extant genera for the hominoids. Data were collected for 20 landmarks covering one os coxa for each specimen. Data were transformed and registered using Generalized Procrustes Analysis. Data were analysed using Principal Components Analysis. Two analyses were performed; one excluding *Homo sapiens*, and the second including them.

Results of the first analysis demonstrate that the total diversity of pelvic morphology is greater in hominoids than it is in cercopithecoidea. This appears to be driven by a combination of both differing locomotory behaviors in the taxa concerned and the greater effects of size diversity (i.e., allometric effects) in the case of the hominoids. The second analysis showed that Procrustes distances were greater between extant *Pan* and *Homo* than they were between any other two catarrhine taxa. This analysis thus quantifies the dramatic effect that the course of hominin

evolution had upon the morphology of the human pelvis.

Biogeography of squirrel monkeys (*Saimiri*).

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Squirrel monkeys are distributed across Amazonia with isolated populations in Central America. Taxonomists disagree over the number of distinct species and species relationships in *Saimiri*. Chiou *et al.* (2011) determined that present-day *Saimiri* diversified in the Pleistocene. Laverge *et al.* (2010) estimated the diversification leading to modern *Saimiri* as significantly earlier, ~ 4.3 Ma; they found support for two main clades of *Saimiri*, including (1) *S. cassiquiarensis*, *S. albigena*, *S. macrodon*, *S. collinsi* and *S. ustus*; and (2) *S. sciureus*, *S. oerstedii* and *S. boliviensis*. Here we analyzed cytochrome *b* data from 35 new *Saimiri* museum samples of wild-caught individuals from Brazil, Bolivia, Peru, Guyana, Colombia, Ecuador, and Costa Rica, along with 41 GenBank sequences. A Bayesian analysis recovered three distinct clades: (1) *Saimiri boliviensis*; (2) *Saimiri sciureus* and *S. oerstedii*; and (3) *S. macrodon*, *S. cassiquiarensis*, *S. albigena*, *S. ustus*, and *S. sciureus* from far northeastern Brazil. We applied a Bayesian discrete-states diffusion model to reconstruct the most probable history of invasion across nine biogeographic regions in *Saimiri* distribution. We used comparative methods to test for dispersal rate variation across the three recovered clades of squirrel monkeys. We calibrated the timing of the splits within *Saimiri* from a fossil-calibrated platyrrhine time tree and compared the timing of invasion of *Saimiri* into different regions to the invasion of these areas by their sister group, capuchin monkeys. Our study provides a major advance in the biogeographic understanding of the expansion of squirrel monkeys across the Amazon Basin and into Central America.

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Reputation dynamics in a Dominican village: altruism, economic competency, and social affiliation.

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Reputations are a ubiquitous feature of human social life and have theoretical and practical importance across a range of contexts including: reproduction, collective action problems, mental and physical health, and human development. Developmental psychologists suggest reputations have great within-individual stability and are likely a dimension of personality, while theoretical biologists suggest reputations have potentially great within-individual flexibility and fluctuate according to behavioral modification. Despite the importance of reputations, little research exists concerning the causes of reputation change

in naturalistic human settings. Two years of behavioral and reputation data from a smallholder Dominican village is presented. Analyses suggest reputations for altruism and labor competency generally are stable over time; however, behavioral modification in economic production can cause reputation change. Interestingly, reputations do not change according to the mechanisms of standing or image scoring strategies as theoretical biologists predict. A novel perspective on reputation dynamics is attempted.

The functions of mutual grooming among wild chimpanzees.

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Although grooming has been extensively studied among non-human primates, these studies have almost all focused on explaining patterns of uni-directional grooming (when individual A grooms individual B, and B does not groom A) and not mutual grooming (when two individuals simultaneously groom each other). This is surprising given that mutual grooming occurs in a number of primate species at varying frequencies suggesting that mutual grooming and uni-directional grooming serve different functions from one another. In this study, we used 17 years of data from the Kanyawara community in Kibale National Park, Uganda to examine patterns of mutual grooming among wild chimpanzees. We specifically tested the hypothesis that mutual grooming functions in the maintenance of social bonds. We found that adult males, who typically form stronger social bonds than females, were more likely to groom each other mutually when compared to female-female dyads. In addition, among male-male dyads, those that exhibited characteristics of strong social bonds, such as high rates of association and low rates of aggression, also engaged in mutual grooming more frequently than dyads with weak social bonds. These results suggest that mutual grooming functions to support the formation of social bonds among chimpanzees. We also found evidence that mutual grooming is a more efficient form of uni-directional grooming. This may allow chimpanzees to offset the opportunity cost of uni-directional grooming, especially when food is less available and there may not be as much time available to devote to social activities.

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Evolution of a HoxD11 enhancer in primates.

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Two characters that bear on the locomotor mode of primates are the lengths of the lumbar and sacrocaudal columns, and the degree to which motion of the most caudal

lumbar is restricted by the ilium. These characters vary most extensively in platyrrhines (New World monkeys). The *HoxD11* gene, part of the genetic toolkit underlying body patterning, is critical to the position of the lumbosacral transition, which bears on this issue. In mouse, a bipartite enhancer (DNA *cis*-regulatory sequence) that controls the precise spatiotemporal expression of *HoxD11* at the lumbosacral transition has been functionally defined (Gerard *et al.* 1997). In this study we investigated whether *HoxD11* enhancer variation and length of the lumbar column are correlated in primates. We PCR amplified, cloned, and sequenced the *HoxD11* bipartite enhancer in multiple primate species including catarrhines: human, gibbon (*Hylobates lar*) and rhesus monkey (*Macaca mulatta*); platyrrhines: titi monkey (*Callicebus moloch*), saki monkey (*Pithecia pithecia*), spider monkey (*Ateles paniscus*), and capuchin monkey (*Cebus apella*); and a strepsirrhine: lemur (*Lemur catta*). Newly generated sequences were analyzed with publicly available orthologs of chimpanzee, orangutan, baboon, marmoset, mouse, and zebrafish. Using Match, a program that predicts transcription factor binding sites and phylogenetic analysis, we found that New World monkeys exhibit unique variability in transcription factor binding sites at the *HoxD11* enhancer. Functional studies may provide insights into whether these base pair changes influence alterations in *HoxD11* spatiotemporal expression at the lumbosacral transition.

Size and shape in the primate forelimb.

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The forelimb is well-represented in the primate fossil record. Many forelimb features are understood to be functionally integral to locomotion. The forelimb must also balance manipulative ability with locomotion, and has likely experienced complex selection pressures. However, morphology cannot be considered independent of phylogeny or body mass. Previous research supports the macroevolutionary hypothesis that body size may be more evolutionarily labile than aspects of shape. One explanation for this is that natural selection more frequently targets body size than morphology; an alternate hypothesis states that shape traits are under stabilizing selection while body size is under directional selection. Macroevolutionary size-shape contrasts in Mammalia have largely been restricted to dental traits, perhaps due to the perception that these are less subject to homoplasy than postcranial traits. However, analyses of the primate skeleton found no significant differences in levels of homoplasy among cranial, postcranial, and dental traits. This study addresses the body size hypothesis using size-shape contrasts of the primate forelimb, including 38 shape variables from the humerus, ulna, and radius of 40 extant primate genera. Pairwise cosine similarity was calculated for species means. A matrix of the cosine similarities, along with a pairwise body size distance matrix, was correlated with a matrix of

pairwise divergence dates. Results indicate that while size and shape have significantly different relationships with divergence time, body size differences have a stronger relationship with divergence time.

Rates of Neandertal introgression in genic versus intergenic regions of the human genome.

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The Neandertal genome project recently estimated that 1-4% of the genetic material found in non-African populations is the result of the introgression of Neandertal genes. When populations that were previously isolated admix, incompatibility at the genic level can often result in distinctive patterns of introgression. It can be predicted that intergenic regions will be more likely to introgress into a population than protein coding changes when two populations or species have lowered hybrid viability or fertility. As coding changes are more likely to be associated with inviability and infertility due to epistatic interactions between gene products, these regions are less likely to be exchanged between diverging populations. Coding regions, therefore, should show an earlier divergence time than intergenic regions. To test this hypothesis, we looked at Neandertal introgression in five genic and five intergenic regions from six geographically distinct modern human populations (Han Chinese, Gujarati Indian, Italian, Puerto Rican, Japanese, and CEPH Europeans). We chose regions with similar recombination rates that did not show strong departures from neutrality. Using maximum likelihood estimation, we calculated the time to the most recent common ancestor (TMRCA) for each of the 10 regions separately based on human-Neandertal-chimp sequence alignments. Our results highlight the patterns of introgression for intergenic and coding regions in different human populations while expanding our understanding of Neandertal population dynamics and raising new questions about human-Neandertal admixture.

The relationship between distal humeral morphology and tail length within the genus *Macaca*.

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Members of the genus *Macaca* exhibit the widest range of tail lengths of any primate taxon, and therefore serve as an ideal group to test hypotheses concerning the evolution of tail loss in hominoids. Hominoid taillessness has been hypothesized to have evolved in association with greater forelimb mobility that would have replaced the role of the tail in maintaining arboreal balance (Kelley 1997). Although macaques have adapted to a life of greater terrestriality compared with early hominoids,

they continue to frequently engage in arboreal behaviour. If the relationship between tail loss and forelimb mobility is valid, shorter-tailed macaques should possess greater forelimb mobility relative to longer-tailed macaques.

To test this hypothesis, 19 skeletal measurements reflecting the degree of mobility at the distal humerus were compared for eight macaque species (n=34) exhibiting a wide range of relative tail lengths. Based on the results of an analysis of variance, a significant difference was found in male macaques (n=19) between articular surface width and tail length (p=0.047), suggesting that tailless macaques possess the greatest width, followed by short-tailed, and long-tailed species. In addition, a least squares regression comparing species means of relative tail length with the mean articular surface width of male macaques resulted in a negative correlation (r²=0.403; m=-2.924) that approached significance (p=0.090). Because larger articular surfaces are indicative of greater joint mobility (Rose 1988), these results provide the first quantitative support for the relationship between tail loss and greater forelimb mobility hypothesized by Kelley (1997).

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Group size and social flexibility among pair-bonded primates.

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Traditionally gibbons (family Hylobatidae) have been classified as living in monogamous social groups with limited variation. This view has eroded as observations of multi-male and multi-female groups have accumulated. Concomitantly, some researchers now describe gibbon social organization as remarkably flexible, a characteristic that more closely allies them with the great apes. To provide context for this assertion we conducted a literature review to determine mean group size and range in gibbons relative to other primates that have been reported to live predominantly in two-adult groups. We predict that if gibbons in fact display greater social flexibility, group size in gibbons will be larger than in other putatively monogamous primates.

Mean groups size in all genera considered was below 5: *Callicebus* [3.2 ± 0.49; (1.7-4.8)], *Pithecia* [4.3 ± 0.99; (2.3-9.0)], *Aotus* [3.3 ± 0.24; (2.3-4.1)], *Hoolock* [3.0 ± 0.20; (2.9-3.2)], *Hylobates* [3.8 ± 0.26; (2.6-5.0)], *Nomascus* [4.3 ± 1.19; (2.0-6.3)], and *Symphalangus* [3.9 ± 0.11; (3.8-4.0)]. Data for a number of other species (e.g., *Presbytis potenziani*) was too limited to allow statistical comparison. Group size among gibbon genera did not differ, but as predicted, group size in hylobatids was significantly larger than in *Callicebus* [t(28.41)=2.75, p=0.011] and *Aotus* [t(57.18)=3.4, p=0.001], though not in *Pithecia* [t(17.8)=-0.76, p=0.480]. Significantly, *Pithecia* is frequently identified as diverging from a strict one-male/one-female social organization. Our results provide broad support for the view that gibbons are more socially flexible than other

monogamous primates. Future analysis will examine group composition and adult sex ratios.

A quantitative assessment of zygomaticoalveolar crest curvature in recent and fossil *Homo*.

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Curvature of the zygomaticoalveolar (ZMA) crest is widely discussed in phylogenetic and biomechanical assessments of craniofacial morphology in Middle and Late Pleistocene *Homo*. However, the complex curvilinear morphology of the ZMA crest has proven difficult to accurately quantify with traditional methods, significantly impeding previous attempts at evaluation. In this study, nine semilandmarks derived from a ridge curve between zygomaxillaire and the alveolar border were employed to accurately measure ZMA crest curvature in a large sample of fossil *Homo* (n = 71) and recent humans (n = 303). A principal components analysis following Procrustes superposition of all semilandmark configurations reveals that PC1 accounts for 57.6% of the total variance and contrasts the degree of curvature along the entire length of the crest (i.e., straight vs. parabolic), while PC2 (18%) contrasts curvature along the lateral ZMA crest related to the medial or lateral positioning of a malar tubercle. Interestingly, PC1 was found to be significantly correlated with facial size both inter- and intraspecifically in *Homo*, indicating that larger faced individuals predictably exhibit straighter ZMA crests, while smaller faced specimens exhibit more arched ZMA crests. Moreover, while contrasted at each end of the size spectrum, ZMA crest curvature actually arrays along a continuous gradient of facial size, and is thus not truly dichotomized into the "arched" versus "straight" polarities often described in the paleoanthropological literature. These results have implications for both the Accretion model of Neandertal evolution, and arguments related to the more "modern" facial morphologies of *H. antecessor* and Chinese *H. erectus*.

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The Shuar Health and Life History Project: lifestyle and dietary correlates of skeletal health among the indigenous Shuar and non-Shuar *Colonos* of Ecuadorian Amazonia.

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Increasing market integration (MI) is characterized by changes in patterns of diet, activity, and individual and community-level socioeconomics, which in turn, have

implications for numerous health outcomes including obesity and hypertension. Minimal research has focused on the effects of MI on skeletal health, an oversight given the enormous health effects of osteoporosis worldwide. This study examines skeletal health in relation to dietary and lifestyle correlates in the Indigenous Shuar of Ecuadorian Amazonia, a forager-horticulturalist population currently experiencing rapid transition to a market economy. For comparative purposes, we also include data from a local, non-Shuar mestizo (*Colono*) population. Participants included 227 Shuar (91 males; 136 females) and 261 *Colonos* (104 males; 157 females) between 15-91 years old. Standard anthropometric dimensions were collected, and skeletal health was determined using a calcaneal ultrasonometer. Measures of MI were obtained using economic, lifestyle, and household food frequency questionnaires, which were reduced by principal components analysis. Multiple regression analyses tested the association between skeletal health and MI factors. Results indicate that Shuar have significantly higher bone values than *Colonos* and other reference populations ($p < 0.05$). Dietary correlates were significantly associated with skeletal health among *Colonos*, while among Shuar, a significant negative association was documented between degree of MI and skeletal health. Shuar individuals who were more market integrated, as opposed to "traditionally" living, had poorer bone health. This study identifies key relationships between skeletal health and cultural and economic change, and has potential for contributing to public health policies for osteoporosis prevention.

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High mitochondrial mutation rates estimated from deep-rooting Costa Rican pedigrees.

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A reliable estimate of the mutation rate of human mtDNA is of outmost importance in evolutionary studies of human population divergence and macroevolution. Yet the estimates obtained in phylogenetic and pedigree-based studies differ, with the former reporting

lower and the latter reporting higher mutation rates.

The purpose of this paper was to determine the mtDNA mutation rate in a pedigree-based study. The data consist of maternal genealogies started from 152 living subjects. We only considered 19 genealogies, which included more than one living descendant, to determine if a mutation had occurred which differentiated the living subjects. Methods used for mtDNA extraction and analysis of the HVRI are in Castri et al. (2009).

We excluded two pedigrees whose living descendants had numerous HVRI differences, indicating that an ancestor was adopted. One of the mutations we observed (at site 335) is reported by Bandelt et al. (2000) as a "speedy site." By eliminating the pedigree with this mutation, we have three mutations in 237 meiotic events with a mean maternal age of 28.3 years. If we use a generation time of 28.3 years we observe a mutation rate of 0.0126, which yields the following estimates: 35.16×10^{-6} substitutions per site per generation, 1.24×10^{-6} substitutions per site per year and a divergence rate of 2.48×10^{-6} substitutions per site per year.

Our study supports previous proposals that the mtDNA clock ticks faster when observed at the minute detailed level of human generations.

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Quantitative histomorphometry of humeral and femoral diaphyses: a longitudinal comparison of osteon population density and primary bone deposition in eight anatomical regions of interest along the bone shaft.

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Comparing bone growth and drift patterns would be very useful for bioarchaeological and skeletal biological inquiry; however this topic is relatively rarely discussed. Our previous studies identified microscopic regional patterning in humeral and femoral endosteal primary bone using hand-drawn areas of measure (i.e., the endosteal lamellar pocket). The current research uses a variation of the point-count technique customized to provide more detailed data on primary and secondary tissue along 4 anatomical axes of each transverse, adult cross-section. Results show remodelling is lessened in the distal femur, particularly the antero-lateral aspect. Conversely, femoral primary tissue is more common distally, but it distributes differently depending on membrane-origin: endosteal tissue, medially with a posterior tendency, and periosteal tissue, anteriorly. In the humerus there is less of a longitudinal trend and endosteal tissue is dependably positioned on the antero-lateral aspect of the cross section; periosteal, on the posterior/postero-medial. Primary tissue was lacking at the linea aspera; whereas the deltoid insertion showed prolific endosteal, but nearly

no periosteal formation. In all cases, results augment and confirm our preliminary observations regarding prior bone drift in these elements: postero-medial in the humerus, and laterally in the femur, *except* that the lateral aspect of the femur contains surprisingly less periosteal tissue than one might expect for a net lateral drift. Implications of this observation could be important in determining the significance of the femoral endosteal deposition's lateral drift, despite the typical achievement of the maximum plane of bending resistance in the antero-posterior plane.

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Incremental enamel development in modern human deciduous teeth.

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Unlike modern human permanent teeth, all human deciduous teeth commence development in utero and birth is recorded at different times in the different tooth and cusp types. Birth can disrupt enamel growth, so it would seem likely that trends in incremental enamel development along the permanent tooth row may not be the same in deciduous teeth. Here, I reconstruct Retzius line periodicity, daily enamel secretion rates (DSRs), pre-natal and crown formation times for an archaeological sample of modern human deciduous mandibular ($n=42$) and maxillary ($n=42$) anterior teeth (canines, lateral and central incisors). Results are compared with previously published data for deciduous molars (Mahoney 2011) to identify developmental trends along the deciduous tooth row.

Like human permanent teeth, Retzius line periodicity did not differ between deciduous teeth in one individual, though periodicity values of 5 days calculated for some individuals are low for modern humans. Unlike some permanent tooth types from extant hominoids, mean daily enamel secretion rates varied between teeth when equivalent enamel regions were compared along the dental row. Incisors had the fastest mean cuspal DSRs (mid and outer enamel range=3.74-5.63 μ m). Mandibular incisors also initiated enamel growth first, had the longest pre-natal formation time (mean=142-166 days) but the shortest crown formation time (mean=282-317 days), and based upon clinical studies are the first deciduous tooth type to erupt. Relatively rapid development in mandibular incisors in advance of early eruption may explain some of the variation in DSRs along the tooth row that cannot be explained by birth.

Biomechanics of spear throwing, with implications for fossil hominins.

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The degree to which skeletal measures available in the fossil record translate to observable differences in performance in living subjects is of primary importance to functional

morphologists. Here the biomechanical effects of body proportions and effective mechanical advantage (EMA) on spear throwing are explored. Kinematic data were collected for 41 subjects throwing a spear-like object, from which joint angular velocities (ω) and linear kinetic energy (Ke) were calculated. Isometric arm strength was assessed with a compression/tension load cell, and EMA and muscle dimensions in the arm were measured using MRI. It was hypothesized that spear Ke would be predicted by body proportions, as well as arm strength and EMA (through their effect on joint angular velocity).

As predicted, EMA and triceps size together explained 48% of the variation in elbow extension ω . However, contrary to predictions, elbow extension ω was not found to be a significant predictor of spear Ke once shoulder Ke was taken into consideration. Shoulder Ke explains 80% of the variation in spear Ke , indicating that the overwhelming majority of the energy provided to the spear is a result of body motion. No aspects of arm anatomy measured significantly explain the residual variation in spear Ke . Furthermore, arm strength is correlated with shoulder Ke , indicating a correlation between arm strength and overall body strength that largely explains throwing performance, while skeletal measurements provide little additional information. This strongly suggests caution should be taken when attempting to infer specific functions from the fossil record without experimental evidence.

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An analysis of the Klasies River hominins using a hybrid model.

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Current research indicates that modern *Homo sapiens* originated in East Africa and then migrated across Africa as well as out of Africa, where they encountered archaic hominins. The Klasies River Main site (KRM) in South Africa is one location where there is evidence that modern and archaic *Homo sapiens* may have interacted. As Smith and other researchers have suggested, the KRM mandibular sample, in particular, exhibits significant size and morphological variability, which counters claims that the KRM specimens are fully modern.

The null hypothesis predicts that KRM's range of variation does not significantly differ from the ranges of variation indicated in the comparative samples, including Sima de los Huesos, Krapina, Skhul, Qafzeh, and the Northern Illinois University (NIU) Collection, the latter containing specimens classified as modern *Homo sapiens* from India. If the null hypothesis is rejected, this would be tentative support that the KRM sample may possibly be a hybrid sample. This study examines first and second mandibular molar lengths and widths as well as mandibular corpus height and breadth in adult hominins and compares patterns of variation using the coefficient of variation.

The results demonstrate that the KRM sample is markedly more variable than any of the comparative samples, which rejects the null hypothesis and is one possible indicator of an admixed sample at KRM. This study is limited by small sample sizes for KRM. This and the fact that KRM spans several thousand years may impact these results.

The seminal importance of the Ipiutak and Birnirk in ancestor-descendent relationships across the North American Arctic.

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The Arctic of North America provides an excellent laboratory for examining historic human population movement and differentiation patterns due to the large number of archaeological sample populations with well established temporal and geographical provenience. This research utilizes cranial morphological variation from 27 discrete Arctic populations spread across the North American Arctic to examine the role that culture and migration may have played in defining biological relationships and population structure among modern human Arctic populations. By examining the pattern of morphological variation using a number of statistics that quantify cranial morphological affinities and hence biological relationships, this work provides a framework for explaining population structure differences and ancestor-descendent relationships across the Arctic. Most prominently, a pattern of ancestry and descent emerges from two primary sources, the Ipiutak at Point Hope and the Birnirk at Point Barrow. Emerging between 1600 and 1400 years before present, these two occupations along the north coast of Alaska are fundamentally important in their contribution to the formation of variation patterns across the Arctic at the time of European contact. The Birnirk at Point Barrow appear to be the formative ancestor to the Thule, which then spread into the Central Arctic and Greenland, while the Ipiutak at Point Hope appear to have stronger affinities with historic west and northwest Arctic populations.

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Facilitating discussion and awareness with the Summer Internship for Native Americans in Genomics (SING).

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Genomics can be a tool of interest for Native American communities. However, Native Americans are underrepresented in occupations and careers incorporating genomics and the sciences in general. Native Americans hold at least 5 times fewer occupations involving science and engineering relative to their total population in the United States. Furthermore, there is a lack of Native Americans in advisory

roles to the scientific community, which prevents proper relay of cultural values and concerns that developed as a result of difficult histories of Native American encounters with science. This lack of leadership also leaves few individuals who can explain the uses and limitations of scientific research to Native American communities who are considering participating in a scientific project. To address this problem, leading Native American academics and advocates organized the Summer Internship for Native Americans in Genomics (SING) at the Institute for Genomic Biology (IGB) at the University of Illinois, Urbana-Champaign. Here I discuss the inaugural SING workshop and its potential to democratize science.

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Dental nonmetric analysis of Tecolote Pueblo: a study of biological distance.

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Archaeological evidence suggests that Tecolote Pueblo, occupied from A.D. 1050-1300, may be a geographic outlier, located at the far eastern edge of Puebloan occupation but still affiliated with the Pueblo. The biological affinity of its residents, however, was not known, as Plains sites have also been recovered very near to Tecolote. Using the dentitions recovered from the site, a dental anthropological approach was used to determine whether the residents' biological affinity was closer to Puebloan or Plains groups. Dental nonmetric traits were recorded using ASUDAS (Arizona State University Dental Anthropology System) standards and compared statistically using the Mean Measure of Divergence and nonstatistically using Turner's expression count method. Results from both methods indicate that Tecolote Pueblo is more closely related to Puebloan than Plains groups. This result supports the results of a previous study based on cranial metric traits that Tecolote Pueblo was slightly, but not significantly, more closely related to the Pueblo. However, multidimensional scaling shows that Tecolote does not fall neatly into the Puebloan group and may be biologically different due to genetic drift.

Influences of natural and anthropogenic landscape features on ranging patterns of white-faced capuchins (*Cebus capucinus*).

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Both environmental and anthropogenic features of the landscape influence nonhuman primate ranging patterns. When traveling to major feeding and resting sites, primates may navigate by orienting to ridgelines and other topographic features in their home range (Di Fiore and Suarez 2007), as well as to anthropogenic disturbances such as pastures, small forest corridors and trees along fencerows. In this study, I examine how ranging patterns of white-faced capuchins are influenced by both environmental and anthropogenic aspects of the

landscape. During June and July 2011, I collected data from a group of 16 white-faced capuchins at La Suerte Biological Field Station in northeastern Costa Rica. Over 38 observation days (134 hours of quantitative data), I recorded the location of the group every 2 minutes, and the location of all major feeding and resting sites using a GPS unit. The group visited 17 major feeding and resting sites from 3 to 16 times during the study period. Travel paths taken to these sites frequently followed fencerows, single lines of trees in regenerating pasture, habitually used routes, particular trees spanning gaps in the canopy, and ridgelines. Of 30 observed river crossings to and from their sleeping site, one particular area was used significantly more frequently than the other 3 possible crossing points ($X^2=18.8$, $df=3$, $p<0.05$). These results indicate that capuchins are highly adaptable to changes that result from anthropogenic disturbance and incorporate natural topographic features of their habitat when navigating between feeding and resting sites.

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Calibrating a conservation strategy for silvery gibbons (*Hylobates moloch*).

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We present a composite picture of silvery gibbon (*Hylobates moloch*) conservation based on both quantitative and qualitative research in West Java, Indonesia. From nearly a decade of monitoring, we report on the changing age/sex composition of groups in the Cagar Alam Leuweung Sancang (CALS). Whilst the census population has remained relatively stable during the study period (2003-2011) loss of individual gibbons and resulting changes to the current effective population size ($N_e=14.0$, or 17.65% decline in five years) are of considerable concern for the long-term viability of this population. Losses of both infant and adult members of the population are likely attributable to an ongoing capture of animals for the live animal trade. Drawing on recent ethnographic research, we examine current threats and conservation tactics, especially in relation to recent confiscation and rehabilitation efforts. We interpret our results from the theoretical perspectives of both community and political ecology. The factors affecting the gibbons in CALS and the social context of current conservation tactics are in many ways representative of conditions throughout the species range. Therefore, this research is pertinent to the development and implementation of a coherent conservation strategy for this endangered species.

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Almost Carioca: hybridization between introduced populations of *Callithrix jacchus* and *C. penicillata* in Rio de Janeiro State, Brazil.

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The importance of hybridization in primate evolution is being increasingly recognized and in Brazil evidence of ongoing interbreeding among Atlantic Forest *Callithrix* (marmoset) species keeps mounting. Marmosets possess a unique suite of primate traits including cooperative breeding and female reproductive suppression. Additionally, several *Callithrix* species are endangered. Yet, the evolutionary consequences of hybridization within *Callithrix* are little understood. To better comprehend marmoset hybridization, we are examining interbreeding between *C. jacchus* and *C. penicillata*. These species are well adapted to the highly fragmented Atlantic Forest and their introduced populations are sympatric with each other and other marmosets. Additionally, reproductive isolation is relatively low within this young genus. These conditions facilitate frequent hybridization in sympatric areas between *C. jacchus* and *C. penicillata* themselves and other marmosets.

We captured, photographed, and collected tissue from 50 exotic marmosets within a hybrid zone in Silva Jardim/Rio Bonito municipalities, Rio de Janeiro state, where introduced *C. penicillata* and *C. jacchus* were first noticed in the mid-1980s. Most captured individuals exhibit phenotypes of mixed parental species traits in ear tuft shape and color. Because few individuals display pure phenotypes, a hybrid swarm may possibly exist within our sampling area. Preliminary results from mitochondrial DNA and phenotypic analyses support the hypothesis that inbreeding is extensive. Collected tissues are also being used for analysis of microsatellite loci to quantify ancestry and gene flow of captured animals. These data will provide a needed genetic perspective of *Callithrix* hybridization for interpretation of hybridization's role in marmoset evolution.

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Vikings, merchants and pirates at the top of the world: Y-chromosomal signatures of recent and ancient migrations in the Faroe Islands.

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The Faroe Islands are a small archipelago in the North Atlantic Ocean. With a current population of approximately 48,000 individuals and evidence of high levels of genetic drift, the Faroese are thought to have remained highly homogeneous since the islands were settled by Vikings around 900CE. Despite their geographic isolation, however, there is historical evidence that the Faroese experienced sporadic contact with other populations since the time of founding. Contact with Barbary pirates in the seventeenth century is documented in the Faroes; there is also the possibility of modern migrations to work in the highly productive fishery. This study set out to distinguish the signal of the original founders from later migrants. Eleven Y-chromosomal STR markers were scored for 139 Faroese males from three geographically dispersed islands. Haplotypes were analyzed using Athey's method to infer haplogroup. Median-joining networks within haplogroups were constructed to determine the phylogenetic relationships within the Faroese and between likely parental populations—Danish, Irish, and Norwegians. Dispersal patterns of individuals around Faroese haplogroups suggest different times of haplotype introduction to the islands. The most common haplogroup, R1a, consists of a large node with a tight network of neighbor haplotypes, such that 68% of individuals are one or two mutational steps away. This pattern may represent the early founder event of R1a in the Faroes. Other distributions, especially of non-Scandinavian haplotypes, document more recent introductions to the islands. The overall pattern is one of a strong founder effect followed by minor instances of later migrations.

The highly polymorphic human cytochrome P450 (CYP) 2A6 gene: examining diversity and nicotine metabolism in a central African foraging population.

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Human cytochrome P450 (CYP) 2A6 is largely responsible for the catalysis of coumarin and nicotine. In comparison to other human loci, CYP subfamily 2A6 exhibits a high degree of polymorphism. Some CYP2A6 gene variants have a major effect on phenotypes. Presently, there are over eighty defined CYP2A6 alleles that fall into three metabolic categories: extensive, poor and null. Broad individual and inter-ethnic difference in nicotine metabolic rate have been documented. For example, Caucasian and African-descent are commonly cited as extensive metabolizers while Japanese are cited as poor metabolizers. Although CYP2A6 has been widely studied, a consensus regarding the evolutionary mechanisms responsible for generating extensive CYP2A6 diversity is lacking in the literature. More CYP2A6 genotyping data from diverse populations is necessary for formulating more precise evolutionary explanations and to date, only one African population has been previously studied. We have conducted a study of CYP2A6

variation and its relationship to smoking behavior in a Central African Aka population—a foraging society that has access to various forms of nicotine. The presence of specific *CYP2A6* alleles in blood spot samples was assayed using RFLP, allele-specific PCR and direct sequencing. Alleles tested include: extensive allele *CYP2A6*1B*, poor metabolizing allele *CYP2A6*9* and poor metabolizing African allele *CYP2A6*17*. These alleles were detected in frequencies similar to those described for African and African-descent populations. We discuss several explanatory evolutionary models of extant variation in the African and non-African *CYP2A6* genotype.

This investigation was supported in part by funds provided for medical and biological research by the State of Washington Initiative Measure No. 171.

Caries in the primary and permanent dentitions.

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A major challenge in studies of dental caries is defining the phenotype. Clinically relevant measures, such as the DMFS index, may not be optimal for identifying risk factors that lead to specific decay patterns, especially if the risk factors (such as genetic susceptibility loci) have small individual effects. We modeled surface-level caries data using hierarchical clustering methods to combine surfaces with similar caries risk into novel phenotypes (clusters). We then explored genetic and non-genetic risk factors for the dental caries clusters. Methods: Hierarchical clustering yielded 6 clusters of permanent dentition surfaces (from 1,069 adults): (cluster 1) occlusal surfaces of molars, (2) mandibular anterior surfaces (incisors + canines), (3) molar and premolar surfaces, (4) maxillary incisor surfaces, (5) maxillary canine and premolar surfaces, and (6) mandibular premolar surfaces. The clusters were used as phenotypes to assess the effects of environmental risk factors, estimate heritability, and perform genome-wide association scans (GWAS). Similar methods were used for surface-level caries data in the primary dentition of 561 children aged 5 years. Results: Some clusters were under genetic control (heritabilities: 31%–54%). Certain caries clusters were associated with environmental and/or genetic risk factors that were not detected using traditional caries phenotypes (DMFS) in this sample. Results of GWAS of cluster phenotypes in the permanent and primary dentitions will be presented. Conclusions: These results support the hypothesis that genetic and non-genetic risk factors lead to specific patterns of decay, and that modeling these patterns improves our efforts to identify the contributors to disease risk.

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An ape's view of language and handedness: consequence, correlation or coincidence?

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The temptation is perennial to link two derived conditions, language and handedness, because each is based in cerebral asymmetry. This inclination may be because both traits appear to be uniquely human characteristics, sharing a common neural substrate. However, in our species' evolutionary past, one may have caused the other, both may be by-products of some third factor, or they may be unrelated. One way to seek to disentangle this puzzle is to look at the two conditions in our closest living relations, chimpanzee and bonobo. The current situation is murky, although all agree that fully-blown semantic and syntactic communication and right-handedness are universal in *Homo sapiens*. But are both features also unique to the hominin line? Two schools of thought have emerged for handedness: One sees signs of rightside-biased manual laterality in apes, while another does not. We assess critically the current evidence from *Pan troglodytes* and *P. paniscus*, using evidence from various contexts: field, lab, zoo, and sanctuary. We focus especially on gestures, that is, behavioural data on unimanual signals that occur spontaneously in ape-to-ape communication. We scrutinise data on variation within and across individuals, populations, and species. We seek to take account of methodological complications that make direct comparisons, much less experimental replications, difficult. We conclude that the evidence for species-level rightside-bias is present, but inconclusive.

Locomotor characterization of the sub-fossil lemur *Babakotia*.

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Palaeopropithecids or “sloth lemurs” are a diverse clade of large-bodied Malagasy subfossil primates characterized by their suspensory positional behaviors. The most recently discovered genus of the family is *Babakotia*. This species has been described as more arboreal than *Mesopropithecus* but less than *Palaeopropithecus*. A remarkably complete skeleton of *Babakotia* is housed at the Division of Fossil Primates of the Duke University Primate Center. To further understand arboreal adaptations of *Babakotia* we compared within bone and between bones articular and cross-sectional diaphyseal proportions of limb long bones of this specimen to suspensory primates (hominoids and monkeys) and true sloths

(*Choloepus* and *Bradypus*). Results show that *Babakotia* humeral articular to diaphyseal proportions are generally similar to those of true sloths than to those of apes. *Babakotia* femoral proportions are also similar to true sloth distributions, but are also similar to lesser apes in their proximal ends (i.e., relative femoral head surface area and superoinferior breadth). Distally, *Babakotia* is closer to great apes and lesser apes than to monkeys; unfortunately true sloth comparative data are missing for this comparison. Interlimb proportions show that *Babakotia*'s relative diaphyseal strengths are similar to the mean value for orangutans and in the range of true sloths. As for interlimb articular proportions, *Babakotia* overlaps with great apes for proximal articulations, but with true sloths for distal articulations. These results provide new evidence on the arboreal adaptations of *Babakotia* and further highlight similarities with both extant suspensory primates and non-primate slow arboreal climbers and hangers, i.e., true sloths.

Age-related changes of the occlusal surface geometry in humans and great apes.

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The surface formed by the dental arcades during occlusion – typically known as the “occlusal plane” – has a complex geometry, which is functionally relevant for the biomechanics of mastication. In dentistry, the geometry of the occlusal surface is defined by the curves of Spee and Wilson, which correspond to anteroposterior and transverse movements of the mandible, respectively. Here, we analyze how the geometry of the occlusal surface changes as a function of dental wear and subsequent compensatory mechanisms of the dentognathic system. We ask whether patterns of occlusal surface change are similar in humans and great apes. We used CT data of a sample of $N=88$ adult skulls of humans and great apes, and quantified occlusal surface geometry with 48 3D-landmarks. Results show that, with increasing dental wear, the occlusal surface changes its geometry from upward-concave to downward-concave. This pattern of in-vivo modification is largely similar in all the examined taxa. Overall, our study indicates that hominoids share a common set of masticatory mechanisms and compensatory dentognathic mechanisms causing occlusal surface change, irrespective of considerable differences between taxa in the architecture of the masticatory system, and in dietary adaptations.

New material of *Anchomomys* (Adapoidea, Primates) from the Spanish fossil site of Caenes (Salamanca).

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The Middle Eocene locality of Caenes (MP15-16), excavated in the 1980s-1990s, yielded scarce, although very interesting, primate material still unstudied. It consists of two complete and one fragmentary right upper molars, and two left mandible fragments, one showing a complete P/4 and the other presenting an almost complete P/4, a partial M/1 and a complete M/2, and both with the rest of the alveoli from the lower C to the M/3.

The upper molars are larger than those of *A. frontanyensis* from Sant Jaume de Frontanya (MP14-15) and show a larger hypocone and a stronger anterocingulum.

In the mandible fragments, the alveoli for the canines are huge. There is a single P/1 alveolus in one of the mandible fragments, although it is missing in the other one. Alveoli for P/2 and P/3 show that these teeth were double-rooted and located obliquely in both mandibles.

The P/4, with continuous buccal and lingual cingulids, a very poorly-developed paraconid, a high protoconid and a small hypoconid, are very *Anchomomys*-like, larger than *A. frontanyensis*. The M/2 presents a high trigonid with no paraconid and a well-developed paracristid, and it is larger than *A. frontanyensis*, differing from it in the more developed premetacristid and the more lingual cristid obliqua.

Even though this material shows differences with *A. frontanyensis*, the only *Anchomomys* species known from Spain, more teeth are needed to determine its specific ascription, as well as its belonging to the Iberian *Anchomomys* lineage, different from that of the rest of Europe.

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Honey, hunter-gatherers, and human evolution.

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Honey is the most energy dense food in nature (Skinner 1991) and important for many hunter-gatherers. The Hadza of Tanzania do not eat insects except for some bee brood when they acquire honey from 7 different species of bees. Of all the foods in their diet honey is their favorite (Berbesque and Marlowe 2009). They often follow the honeyguide bird (*Indicator indicator*), which leads them to bee hives. They use wooden stakes, axes, and torches when they climb tall baobab trees to raid large bee hives. The torch smoke causes bees to engorge themselves on honey in preparation for moving the hive and it masks alarm pheromones, calming the bees, resulting in fewer stings. These tools make humans capable of acquiring much larger amounts of honey than our great ape

relatives. The amount of honey acquired varies greatly, 19 times more in the rainy than the dry season. Virtually all warm-climate foragers have honey in their diet. Of the 27 foraging societies in the Standard Cross-Cultural Sample with data on honey consumption, 13 do and 14 do not eat honey. The latter all live in cold climates with effective temperature below 13°C where honey is rare to nonexistent. Of the 14 societies in warmer habitats 13 (93%) do acquire honey. Given that our great ape relatives acquire honey, it seems likely that honey has been a part of the hominin diet since before the Homo/Pan divergence, increasing with increasing sophistication of tools that aid in getting access to bee hives.

Osteoarthritis of the hands: analyses of bones from the Coimbra identified collection (19th-20th centuries).

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Osteoarthritis (OA) is one of the most prevalent chronic rheumatic diseases in modern and archeological populations. This study aims to determine the frequency of osteoarthritis in hand bones and the biographic profiles of the individuals affected.

A sample of 123 individuals (62 males/61 females), from the Coimbra identified collection, (age at death ranging from 30-96 years old; mean=57.7; S.D.=17.63 years), was studied. OA was diagnosed applying the criteria proposed by Rogers and Waldron (1995).

The prevalence of OA is 56.1% (n=69/123), diagnosed in 57.4% of the females (35/61) and 54.8% (34/62) of the males with no statistical differences ($X^2=0,01$; d.f.=1; p=0,919) between sexes. The mean age at death of the individuals with or without OA is, respectively, 65.1 and 48.4 years old. Right hands (49.6% or 61/123) were more affected than left (45.5% or 56/123), however this difference is not significant ($X^2=0,26$; d.f.=1; p=0,609), manifesting most frequently a bilateral pattern (69.6% or 48/69). According to the occupation, 53.3% (23/44) of the artisans/blue color workers and 49.2% (30/31) of the housekeepers/housewives presented respectively more OA in the right and left hands. There are small differences in the frequencies of bones with OA, with the first metacarpal, 26,3% on the right (31/118) and 21,2% (25/118) on the left, being the most affected.

These results bring new data about OA distribution in hand bones. More research in paleopathology is necessary on this topic.

Ecological and social influences on habitat use by Bornean orangutans.

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Understanding the factors that influence variation in orangutan population dispersion in space and time would both enhance our understanding of orangutan socioecology and contribute meaningfully to the conservation of this threatened taxon. We use data from a six year study of a population of Western Bornean Orangutans (*Pongo pygmaeus wurmbii*) at Gunung Palung National Park, West Kalimantan, Indonesia to test hypotheses about 1) the role of food resources (and different classes thereof) in determining orangutan dispersion across space and over time, and 2) how different age-sex classes respond to the availability of food and presence of conspecifics. We assessed orangutan population dispersion across seven distinct tropical rainforest types (spanning lowland peat swamp to montane forest) using direct observations of orangutans on fourteen survey transects. We also monitored the availability of orangutan plant foods monthly in ten randomly-placed phenology plots in each of the seven forest types. Orangutan population dispersion varied radically over the six year period, as did the absolute and relative availability of food in each forest type. The results of general linear models support the hypotheses that orangutan populations at Gunung Palung partially buffer themselves against resource scarcity by switching habitats, that population movements are best explained by the abundance of preferred foods, and that peat swamp forests serve as "fallback habitats." Furthermore, patterns of dispersion differed among age-sex categories: as predicted by socio-ecological theory, movements of adult females across the landscape tracked variation in food availability far more closely than any other age-sex category.

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Ancient DNA from the Angel Mounds archaeological site.

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Angel Mounds is a Middle Mississippian archaeological site (ca. A.D. 1050-1400) on the Ohio River in southwestern Indiana. Beginning in the WPA era and continuing through the mid-1970s, the remains of over 200 individuals were excavated from Angel Mounds. These remains are now curated at the Glenn A. Black Laboratory of Archaeology at Indiana University in Bloomington, where they are utilized in bioarchaeological research. The current report summarizes the results of the Angel Mounds ancient DNA project in which 100 individuals were tested for the presence of mitochondrial DNA using standard ancient DNA methods. Unfortunately, many individuals in the Angel Mounds skeletal series were affected by poor DNA preservation, which can be attributed to the sun drying of human bones during excavation. Standard protocol in ancient DNA research requires the confirmation of genotypic data through two independent DNA extractions; however, due to the DNA degradation of the

Angel Mounds skeletal series, confirmation was not always possible. Given this issue, the results presented in this report must be considered with caution. Mitochondrial haplogroups were assigned to 25 individuals at the following frequencies: A2 – 52%, B2 – 4%, C1 – 20%, C4c – 8%, D1 – 12%. These haplogroup frequencies were not significantly different from what was reported in similar studies of Midwestern archaeological samples. This project reinforces the fact that ancient DNA research may be adversely affected by excavation methods and/or long periods of curation.

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Complexity in cutmarks, burning and breakage of human bones at La Quemada: distinctive patterns from different contexts.

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Human remains recovered from the hilltop fortress-monument of La Quemada (circa AD 500-900) in northern, Mexico, revealed distinctive modification and processing. Over 800 individual bone fragments were examined for cultural modification using White's (1991) criteria. The bones were retrieved from one of at least 60 terraces at La Quemada. At a location below and to the west of the site's monumental core, it corresponds to the directionality of death in Mesoamerican cosmology. The terrace supported a temple, ball court, banquettes, walkways, patios, small rooms, and causeway-staircase connections to the outer world and the inner monumental precinct. Identified were at least five different patterns: (1) in the temple, disarticulated bones showed signs of dismemberment, defleshing, and curation, suggesting ancestor veneration; (2) on the adjacent banquette, a highly visible feature of the ancient walkways, there was reduction in overall bone sizes with selective use of bone shafts with ends broken off, suggesting a display of bones, possibly of enemies; (3) in the patio, there is reduction, breakage and discard suggesting selective use of some bones and discard of other bones representing feasting (and possibly cannibalism); (4) in Midden 1 there are bones that were dismembered, defleshed, discarded and broken, possibly representing feasting discard; (5) Midden 7 had bones with the above signatures in addition to some unusually modified bones suggestive of ritual or trophy bones. We explore the significance of keeping such bones amidst an active living space, suggesting that it marks a deliberate, cosmological juxtaposition of life and death.

Influence of aquatic resources and subsistence strategy on human milk fatty acid composition: a cross-cultural analysis.

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The long-chain polyunsaturated fatty acids (LCPUFA) arachidonic (AA, 20:4n-6) and docosahexaenoic acid (DHA, 22:6n-3) are essential to early primate growth and development, particularly of the neural and visual systems, and are the most abundant LCPUFA in maternal milk. In humans, the percentages of AA and DHA in milk—derived primarily from maternal fat stores and secondarily from current dietary intake—are highly variable across populations. Milk DHA percentages in most Westernized populations are generally low (reflecting n-6 rich and n-3 poor diets), leading some researchers to suggest that milk DHA standards should derive from populations consuming traditional diets. We recently found significantly higher percentages of AA and DHA in the milk of women from an Amazonian forager-horticulturalist population (the Tsimane) as compared to a lactational age-matched sample of Midwestern U.S. women.

We further compared the Tsimane and U.S. DHA values to those reported in studies across 50 nations, and found women from populations with regular aquatic (marine, lacustrine, riverine) resource consumption showed the highest percentages of milk DHA, irrespective of subsistence economy (i.e., “traditional”, “industrial”). In addition, mean milk DHA percentages from human non-aquatic consumers are more similar to those of non-human primates than they are to human aquatic consumers. Milk fatty acid composition of women who regularly consume aquatic resources may serve as a better reference standard for comparative studies of maternal and child nutrition, primate milk composition in relation to brain size, and hominin evolution.

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On the origin of language: the Atapuerca evidence.

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The Sima de los Huesos (Sierra de Atapuerca, Spain) has yielded a large collection of Middle Pleistocene human fossils that represent the ancestors of the Neandertals. Among the fossils recovered from the site are a very complete cranium (Cranium 5) and its associated cervical segment of the spinal column, two hyoid bones and nearly 30 middle ear ossicles. The preservation of these skeletal elements makes it possible to reliably reconstruct the basic aspects of the anatomical regions that are responsible for the production and perception of the sounds that comprise human speech. The proportion between the horizontal and vertical segments of the supralaryngeal vocal tract and the human-like anatomy of the hyoid bones demonstrate that the skeletal characteristics implicated in speech production in modern humans are ancient features of the genus *Homo*. At the same time, the skeletal characteristics of the outer and middle ear associated with modern human auditory capacities and speech perception are also present in the SH hominins. In order to quantify the link between sound perception and communication, we have analyzed the capacity of the outer and middle ears as a communication channel. The presence of a widened bandwidth of hearing in the SH hominins suggests the ability to transmit and receive a large amount of information compared to chimpanzees. In sum, the SH hominins, and by extension their Neandertal descendants, already possessed all the anatomical characteristics that facilitate efficient production and perception of the sounds on which the human vocal communication system is based.

Evolutionary change in the hominin orbit: an analysis of orbital morphology in relation to neurocranial expansion and reduced facial prognathism since the middle Pliocene.

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The principal aim of this study is to examine variation in orbital morphology in relation to long-term evolutionary trends of cranial expansion and reduced facial prognathism during hominin evolution. The orbit has not been investigated in the context of these morphological shifts, but is important to understand given its position amid these coalescing craniofacial features.

Samples used in this analysis include *Pan troglodytes*, *Australopithecus africanus*, *Homo erectus*, Archaic *Homo sapiens*, and anatomically modern *Homo sapiens*, each representing different grades of cranial expansion and facial prognathism. Orbital, neurocranial, and facial measures were taken from original specimens and casts at museums in South Africa, France, Monaco, and the United States, and were size-adjusted prior to analysis to account for body size differences among groups. Linear Regression and Principal components analysis were used to examine variation in orbital size/shape relative to cranial size and degree of facial prognathism.

All orbital traits were found to vary in association with change in these features, becoming vertically shorter, horizontally elongated, more frontated, and retracted relative to basion, with a greater degree of posterior reduction in the inferior orbital margins. These changes would be expected in association with the brain expanding and moving anteriorly out over the orbits, while the lower face retracts posteriorly toward them. Future research should employ high resolution imaging techniques to examine variation in size and shape of the internal aspects of the orbit, particularly given the degree to which the forebrain has grown out over this feature in recent human evolution.

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Ancient DNA evidence of population replacement following the Aztec conquest of Xaltocan, Mexico.

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The Otomi city-state of Xaltocan was an influential polity in central Mexico in the 11th-14th centuries, but its preeminence declined when it was conquered by the neighboring city of Cuauhtitlan in 1395. According to colonial documents, the Otomi population abandoned Xaltocan at this time and the site remained uninhabited until it was incorporated into the Aztec empire in 1428 and repopulated by the Aztecs. However, more recent archaeological finds (e.g., burials dated to the supposed abandonment period and continuity in the location of residential and funerary constructions) suggest that a significant portion of the Otomi population may have remained at Xaltocan after 1395 and even under Aztec rule.

To help resolve questions about population replacement at Xaltocan during this period, we extracted ancient DNA from 21 individuals recovered during archaeological excavations in Xaltocan. These individuals were buried outside houses in a mound containing stratified domestic deposits, and they can be divided into two temporal subpopulations (before and after AD 1395). We determined mitochondrial DNA haplogroups through RFLP analyses and constructed haplotypes based on 359 bp of HVR1 sequence. All results were verified through multiple independent extractions and amplifications.

Network analyses showed that distinct haplotypes were present in each subpopulation, and a test of population differentiation rejected the null hypothesis of population continuity. We also used computer simulations to further evaluate the evidence for population replacement. Altogether, our results suggest that the matrilineal population at Xaltocan underwent a significant replacement event after 1395.

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The functional morphology of the scapula.

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The shoulder girdle is an ideal anatomical area for studying the locomotion of primates and early hominids because it is involved in nearly every act of locomotion. Paying special attention to the form of locomotion, we can identify several features on the scapula that differ among the different species.

For this study the scapula of humans, chimpanzees, orangutans, gibbons, gorillas and baboons were analysed (total n=286) and compared to casts of the scapula of A.L. 288-1 (*Au. afarensis*), Sts 7 (*Au. africanus*), Stw-431 (*Au. africanus*), MH2 (*Au. sediba*) and KNM WT 15000 (*Homo erectus*) and pictures of DIK 1-1 (*Au. afarensis*). For the measuring of the scapula, landmarks were defined, digitised by using the MicroScribe-3DX and later transformed into distance measurements.

The results of the scapular index, the supra- and the infraspinous index showed us that the long and narrow form of the hylobatid scapula reflects a specialisation of the shoulder for brachiation while the human scapula is wider than long and shows the reduced amount of external stress on the scapula due to its release of all direct duties of locomotion.

The small axilloglenoid angle we found in gibbons but also in the orangutan, chimpanzee and the Australopithecus helps to place the arm in an overhead position, ideal for brachiation and climbing, whereas in humans and quadrupedal primates (baboon and gorilla) we found a higher value for this angle, which reflects an adaptation of the arm for its use in a lower position of the joint axis.

A comparison of gross morphology and histomorphometric age-at-death estimation techniques on a known forensic sample.

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A comparison of macroscopic and microscopic age related changes to the skeleton could enhance the understanding of the ageing process and improve age-at-death estimation. This study evaluates the utility of multifactorial age estimation methods by comparing macro- and microscopic analyses with the goal of producing more accurate and precise age-at-death estimates.

Gross morphology and histomorphometry age estimation methods were applied to a sample of known individuals (n=40) from a modern forensic population. The pubic symphysis, sternal 4th rib ends, and 6th rib midshafts were collected and analyzed. In addition, three multifactorial ageing methods incorporating both gross morphology and histomorphometry data

were tested on the sample: 1) FAU technique, 2) Statistical average, 3) Adjusted Stout et al. (1994). The accuracy, inaccuracy, and bias values were compared for each ageing method.

The results of this study indicate that both the gross morphology and histomorphometry methods performed well; however, method accuracies ranged from 60-95%. The results also show that multifactorial methods incorporating histomorphometric and gross morphology data improve the final age-at-death estimates by lowering the inaccuracy and bias values. Specifically, incorporating the pubic symphysis as an indicator of relative age (as per the FAU technique) improves inaccuracy and bias for histomorphometric age-at-death estimates. This analysis promotes future development of multifactorial age estimation methods that incorporate both macro- and microscopic examination of bone for use in forensic and bioarchaeological contexts.

Birth size, early weight gain, and diet: relationships to weight-for-length during the first year.

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Data were collected for 187 infants enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Data were collected for all infants during an initial clinic visit (mean age 5.7 weeks) and at a follow-up visit (mean age 29.0 weeks). Feeding was classified based on breastfeeding status at the time of the second clinic visit. Early weight gain was measured as change in weight z-score between birth and the first clinic visit. Early weight gain, birth weight, feeding, and ethnicity were tested as predictors of weight-for-length z-score at the second clinic visit.

Greater early weight gain and birth weight predicted higher weight-for-length z-score at the second clinic visit. Not breastfeeding at the second clinic visit also predicted higher weight-for-length z-score. Nearly all infants (99%) that were not breastfed received formula and 39 percent of breastfed infants received formula. Accelerated growth during prenatal or early postnatal life may have lasting effects on body composition and term infants at both ends of the birth weight distribution may face higher risk of elevated weight-for-length. Breastfeeding may mitigate effects of early rapid weight gain on subsequent growth.

Stigmata of congenital syphilis on two high status pre-Columbian juveniles from Oaxaca, Mexico.

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Differential diagnosis of congenital syphilis from skeletal remains should consider all bony and dental manifestations. The presence of dental stigmata in two juveniles from the

Pacific Coast of Oaxaca, Mexico (late Terminal Formative Period, 150 BCE – CE 250) is discussed. Both children were likely high-status members of pre-Colombian populations. The first child, was from the site of Yugüe, and was found with a green stone bracelet. The second child, from Cerro de la Cruz, was interred with 1 bowl, a necklace of 22 canine teeth, and was in direct association with two other burials.

Additionally, a two-tier system is introduced for describing dental malformations that may suggest either environmental variation in the bacterial assault or in host response. Taphonomic changes precluded in-depth observations of the skeletons, dental traits such as plane-like hypoplastic defect and Fournier's molars are described and compared to previous studies. The individuals presented here are from early Mesoamerica cultures with dentition that resembles the dental stigmata of others who have been described as having congenital syphilis.

Funding for the osteological field research was provided by grants from the College of Arts and Letters, Research, Scholarship, and Creative Activity Grant (RSCA), and the University Grants Program, San Diego State University.

Reproductive decision-making in the Bolivian Amazon: why do fertility preferences not match outcomes?

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We examine ideal family size (IFS) among Tsimane Amerindian women, and explore why fertility often exceeds IFS. We test three hypotheses for why women often exceed their IFS, despite improvements in the socioeconomic environment: (H1) limited female reproductive autonomy; (H2) improved maternal condition without effective fertility control methods; (H3) lack of perceived returns on investments in embodied capital.

Reproductive histories and prospective fertility on 305 Tsimane women were gathered by the Tsimane Health and Life History Project from 2002 to 2008. Semi-structured interviews were also collected among 76 women to study perceptions on costs of parenting and social aspirations. IFS and fertility are analyzed using multiple regression, t-tests and ANOVA.

Of the three hypotheses tested, (H3) received the most support. There is little overt motivation to pursue education and delay reproduction. Economic returns for educational investment are low, and there is little overt desire to emulate low fertility Bolivian nationals, even among the most acculturated women. Instead, substantial value is placed on maintaining traditional skills and lifestyle.

Women's IFS is a useful measure to bridge between fertility-related beliefs, perceptions and outcomes at the onset of a demographic transition. Many women in developing countries may exceed their IFS due to the low perceived or real benefits of investing novel forms of human capital in self and offspring. Somatic wealth and large kin networks may persist as the most important components of social success, and so fertility remains high.

How social is inequity aversion in humans? Like nonhuman primates, children reject inequity in a nonsocial game.

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Inequity aversion (IA), which is intolerance for uneven reward distributions, is an important component of the human sense of fairness. IA is normally assumed to occur only under social conditions and thus virtually no study of IA in humans has tested whether individuals reject unfair offers in nonsocial contexts. Studies of IA in nonhuman primates (hereafter primates), by contrast, test IA in both social and nonsocial contexts and evidence for IA hinges on the demonstration that subjects reject inequity more when they are paired with a social partner than when no partner is present. Indeed, some primate studies have shown that responses to inequity are strongest in social conditions. However, individuals in these studies also typically reject unequal offers in nonsocial conditions. Rejections in a nonsocial context suggest that primates react differently to inequity in comparison to humans. Here, we test this hypothesis by examining IA in children in a nonsocial game.

We tested 185 4-9 year old children in a nonsocial economic game where subjects could accept or reject equal and unequal offers of candy. Results show that 6-9 year old children reject inequity in this game. These results are compared to those from a social version of the game (Blake and McAuliffe 2011), which shows that, like primates, individuals exhibit stronger IA in a social context.

More broadly, these results suggest that a simple mechanism whereby individuals gauge their payoffs relative to those available may be the evolutionary starting point for a more derived form of social IA.

Infectious disease risk in the evolution of culture.

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Culture has played a major role in human evolution, and behavior patterns implicated in cultural development, such as innovation, extractive foraging, and social learning are observed in diverse animal species. Understanding the costs of these underpinnings of culture is necessary to understand how and why culture emerges along some lineages but not others. One such cost is infectious disease. Specifically, higher frequency of innovation or extractive foraging may be associated with greater environmental transmission of parasites,

while higher frequency of social learning may be associated with greater social contact and, thus, more socially transmitted diseases.

We investigated these links using phylogenetic comparative methods, controlling for sampling effort, body mass, group size, and geographic range size. We predicted positive associations between parasite species richness and observed frequencies of innovation, extractive foraging, and social learning. Among 127 primate species, we found a positive association between total parasite richness and total observations of the three studied behavior patterns recorded for each host species. This relationship was driven by two independent phenomena: contagious diseases were positively associated with rates of social learning, and environmentally-transmitted diseases were positively associated with rates of innovation and extractive foraging. We found evidence for moderate phylogenetic signal in the statistical models.

Based on these findings, we propose that parasites are a potential cost of behavioral patterns vital to the evolution of culture. Our study calls for further investigation into infectious disease and other ecological factors as constraints on the evolution of culture in humans and other animals.

This study was funded in part by the National Science Foundation Graduate Research Fellowship under Grant No. DGE-1144152, Utrecht University's High Potentials Programme, and the Netherlands Organisation for Scientific Research (NWO) Evolution and Behaviour Programme; training in phylogenetic comparative methods was provided by the AnthroTree Workshop, which is supported by the NSF (BCS-0923791) and the National Evolutionary Synthesis Center (NSF grant EF-0905606).

Nursing and maternal energy balance in wild Sanje mangabeys, *Cercocebus sanjei*, in the Udzungwa Mountains, Tanzania.

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Lactation is generally accepted to be the most energetically expensive period of primate reproduction as milk production and infant carrying drain maternal energy. Until recently, it has been difficult to document these energetic costs in wild primates. By analyzing the urinary C-peptide of 21 wild female Sanje mangabeys, *Cercocebus sanjei*, we investigated the costs of time spent nursing and infant dependence on maternal energy balance. C-peptide levels were negatively correlated with time spent nursing (Pearson correlation = - 0.598, $p < 0.05$), which decreased over time as infants aged. Infant mangabeys remained in contact with their mothers for the first three months of life, at which point they became more independent. We found a significant decrease in time spent nursing between these dependent ($\bar{X} = 0.26 \pm 0.11$) and independent periods ($\bar{X} = 0.05 \pm 0.06$; independent samples t-test: $t = 9.46$, $p < 0.001$). Weaning was defined as the point at which mothers spent less than 5% of their observation time nursing (infant age: $\bar{X} = 11$ mon); however,

short bouts of suckling were observed daily for most weaned infants. Further, 86% of pregnant females (6 of 7) allowed their infants to suckle at least one month into the subsequent gestation period. Two of these females tolerated suckling within weeks of parturition. Though suckling is often thought to prevent cycle resumption, these results demonstrate that both processes are possible among well-nourished Sanje mothers, provided a positive energy balance can be maintained.

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More mobile than most? AP tibial expansion in the DeArmond mound.

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DeArmond (40RE12), a Mississippian site in the Watts Bar Basin of east Tennessee excavated during the WPA era, has only recently begun to receive systematic examination by researchers. Biodistance analysis has indicated that the people of DeArmond shared close biological affinity to the people of Dallas in the Chickamauga Basin. However, despite their biological relationship and shared subsistence patterns, males from the DeArmond mound demonstrate a significant difference in tibial morphology from their counterparts in the Dallas site. T-tests performed on three tibial measurements demonstrated no significant difference in maximum length (TML) or medial-lateral diameter (MLM); however, DeArmond demonstrated significant expansion in the antero-posterior aspect (APN).

Based on these results, DeArmond was further analyzed with Native American sites representing seven subsistence types (n=1171) to determine how they compared to other agriculturalists as well as groups with different subsistence patterns. Discriminant analysis showed that the DeArmond mound male tibial morphology was more characteristic of village horticulturalists, while the tibiae from the Mississippian sites of the Chickamauga Basin classified like those of agriculturalist groups as expected.

Village horticulturalists are classified as having high mobility and high activity levels with agriculturalists having low mobility and high activity. Based on these preliminary results, we may question whether DeArmond Mississippian males were more mobile than previously assumed, or if there was an activity in which they participated that excluded other segments of their society. Further research may determine the etiology of the tibia morphological difference observed at the DeArmond site.

Encephalization in Pleistocene *Homo* revisited.

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Recent analyses of body mass and encephalization quotient (EQ) find that EQ is similar in early *Homo erectus* and australopiths, and either remains fairly low or increases greatly throughout the Middle Pleistocene. Differences in sample composition and methods make choosing between these conflicting results problematic. In this study, we assembled a large dataset of hominin cranial capacities and body masses in order to assess the tempo and mode of EQ change through time. We calculated EQ for specimens with associated crania and postcrania (EQ1); and for species, using associated (EQ2) and unassociated (EQ3) crania and postcrania, and crania only (EQ4). This study design allowed us to test the effect of different methods and sample composition on EQ. In addition, we used hypothetical growth curves to increase body mass values for key juvenile specimens from Malapa, Dmanisi and West Turkana. New EQ estimates for Dmanisi D2700 and KNM-WT 15000 allow us to reject the hypothesis that EQ does not differ between australopiths and early *H. erectus*. Systematic differences between EQ estimates calculated in different ways suggest that EQ in Middle Pleistocene *Homo* has been both under- and overestimated in the recent literature. EQ increases in a step-like fashion in australopiths, early *H. erectus*, archaic *Homo*, and Neanderthals and *H. sapiens*. With the possible exception of *H. erectus*, EQ seems to remain static within species over long time periods. These results underscore the mosaic nature of brain and body evolution in Pleistocene *Homo*.

Unexpected pollex and hallux use in wild *Pongo pygmaeus wurmbii*.

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The relatively short first ray compared with digits 2-5 of orangutan hands and feet has led to the general assumption that the orangutan pollex and hallux are not extensively recruited during positional behaviors. Earlier studies of captive orangutans appeared to support the assumption that the first rays were rarely used in favor of grasps that involved digits 2-5, perhaps reflecting locomotor adaptations for grasping thin vine-like substrates encountered in their natural habitats. However, the natural habitats of orangutans are now known to include a wide

variety of differently sized substrates and a reexamination of how orangutans use their manual and pedal digits in the wild is clearly warranted. We examined 326 minutes of digital video of wild orangutans from the Tuanan Research Station, located in Central Kalimantan, Indonesia, and recorded in seconds all instances and durations of digit use. Of the 6781 seconds where the hallux was visible, 43.6% involved actions that included recruitment of the hallux whereas only 19.5% involved toe-only actions (p<.001). Of the 5848 seconds where the pollex was visible, 53.2% involved actions that included recruitment of the pollex whereas only 11.4% involved finger-only actions (p<.001). Other interesting findings include slightly more frequent use of the pollex compared with the hallux (p=0.05), toes are used roughly twice as often compared with fingers (p<.001), and the left and right hands are utilized equally (p=0.49). In total, these data demonstrate that wild orangutans recruit their first rays far more often than has been assumed in studies of functional morphology.

The relationship between cortical bone thickness and curvature in metatarsals of *Homo* and *Pan* and implications for hominin foot morphology.

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Hominoids practice a diverse array of locomotor behavior, from obligate terrestrial bipedalism to arboreal suspensory behavior, which is reflected in the variable morphology found in their foot bones. That hominin foot bones reflect locomotor behavior is also clear, but the forms of locomotor behaviors to be inferred are less clear. Pressure plate studies indicate that the center of pressure tends to move medially in the human foot during the last half of stance phase of bipedal gaits, while it tends to remain relatively more lateral in the chimpanzee foot during the last half of stance phase. Here we compare metatarsals of *Homo sapiens* [n=25] and two species of *Pan* (*Pan paniscus* [n=16] *Pan troglodytes schweinfurthii* [n=23]) in order to explore *Homo* and *Pan* metatarsal morphology and foot function. Specifically, we address whether cortical thickness is associated with diaphyseal curvature in metatarsals. We also track these associations across metatarsals of the foot in order to determine whether species exhibit medial versus lateral trends suggested by plantar pressure studies.

We evaluate thickness of cortical bone along metatarsal diaphyses (I-V) using linear dimensions at medial, lateral, plantar and dorsal regions of interest (ROIs), which are coordinated with morphometric thickness maps of diaphyses. The relationship between diaphyseal curvature and cortical thickness at plantar and dorsal ROIs differs. These relationships are evaluated within the sample for single metatarsals as well as across metatarsals within a foot. Implications of these relationships for hominin foot form and function are discussed.

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Growing up gibbon: evidence for direct teaching and social learning in a cooperative breeding ape, the siamang (*Symphalangus syndactylus*), at the El Paso Zoo.

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The cooperative breeding hypothesis suggests that species relying on allomaternal care should show more teaching-like behavior and social learning than independent breeders like chimpanzees. To test this hypothesis in the closest sister group to great apes, approaches to parenting and juvenile learning were examined in a family of siamangs at the El Paso Zoo. The study extends from before the couple had offspring in 2006, through the birth of a female in 2007 and of a male in 2011, to the present. Both the adult male and juvenile female exhibit allomaternal behaviors.

From January 2009 to May 2011 the adult siamangs were observed using a particular set of logs as a latrine, a family custom not practiced by wild siamangs. During 2009 and 2010 the juvenile female always joined her mother on the latrine and expressed great curiosity toward latrine use, but was not observed using it herself. In January 2011 the adult male began actively teaching the juvenile latrine use. On one occasion he pulled her by her hand to the latrine and bared his teeth at her until she sat on it and used it. On another occasion the three year old went to her father and pulled on his throat sac until he took her by the hand down to the latrine, where they both used it while sitting next to each other. This and other examples are interpreted as evidence for direct teaching, social learning and shared intentionality in siamangs, supporting the cooperative breeding hypothesis.

Environmental risk, perceived mortality risk, and facultative adjustment of life history strategy among young adults in the United States.

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Mortality risk is key to defining life history tradeoffs, including allocations of effort to growth, reproduction, and maintenance, and the scheduling of important life history events such as age at maturity. In affluent, industrialized settings like the contemporary United States,

energetic constraints are minimal and exogenous mortality risk is very low by historical standards. However, psychosocial stressors in infancy and childhood may still signal "risk" and influence life history strategies. We investigate this possibility using data from a large, nationally representative cohort study of young adults in the U.S., with the latest wave of data collected when participants were 24 to 32 years old (n>15,000). We use a series of regression models to investigate early psychosocial stressors as predictors of age at menarche for females, and patterns of reproductive activity for females and males. We also investigate indicators of investments in growth (height, weight) and maintenance (cell mediated immune function, health behaviors) as outcome variables. Lastly, we consider perceived mortality risk as a cognitive mechanism that may mediate associations with "risky" early environments. Analyses indicate the following: 1) adversity in childhood predicts earlier and more intensive reproductive effort; 2) adversity is associated with higher perceived mortality risk; and 3) higher perceived mortality risk predicts increased reproductive effort and reduced maintenance effort, as defined by health behaviors that protect against diseases of aging. These results highlight the utility of an integrated life history framework for understanding the long-term impact of psychosocial stressors early in development.

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A fine grained but nondestructive method to determine the timing of enamel hypoplasia.

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Enamel hypoplasia is a useful indicator of systemic stress experienced during childhood. The time dependent nature of enamel formation allows hypoplastic defects to be related to the age of the individual when the defect was formed and therefore when the stress event occurred. Unfortunately, accurate age determinations have only been accomplished through histological analysis of cross sectioned teeth, which is time consuming and necessitates the destruction of the teeth. However, recent research has identified a strong negative correlation between the total number of striae of Retzius in lower canines and the number of days associated with their regular occurrence, or periodicity. This relationship may allow for a tooth's periodicity to be determined from a surface examination, allowing a more precise age estimate to be established, without the need to destroy the tooth.

The research presented here has investigated this correlation in a different population in order to, firstly, see if it is present and, secondly, whether counts of perikymata in particular deciles of crown height may be able to be used to estimate periodicity, as previous research has suggested. This involved the histological analysis of cross sectioned mandibular and maxillary canines from a modern New Zealand population. Results demonstrate that the phenomenon is present in a different population and, in particular, that the number of perikymata in the 8th and 9th deciles of crown

height may be associated with a canine's periodicity. Finally, a non destructive method to estimate the timing of hypoplasia based on externally assessed periodicity is proposed.

The influence of the forest edge on activity patterns and postural behaviour of *Propithecus coquereli* in northwest Madagascar.

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Habitat edges and the resulting edge effects can cause changes in the abundance and distribution of food resources which can influence animal activity patterns. The objective of our study was to determine if and how forest edges influences primate behavioural patterns.

We conducted full-day follows of four groups of *Propithecus coquereli* in Ampijoroa, Ankarafantsika National Park, NW Madagascar - two that ranged less than 1-km from a forest edge and two that ranged greater than 1-km from the edge. We compared activity budgets and postural behaviors between the groups.

We found no significant differences in activity budgets. Groups did show differences in the spatial pattern of behaviours based on a joint-count analysis, however. One of the groups closest to the edge exhibited a clumped pattern in feeding locations. This could be indicative of microhabitat differences in food distribution between the group ranges. Groups also showed differences in substrate size and vertical location used while traveling - groups nearer to the edge used smaller substrates less frequently and travelled in a climbing posture more frequently than groups in the interior. This may allow for increased vigilance in the face of potential hunting pressures.

Although the groups did not differ in their overall activity patterns, there were more nuanced differences that may reflect differences in resource distribution and could be edge-related. The results of this study highlight how habitat alterations and edge effects can impact the behaviour and ecology of a primate species.

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Enamel thickness and hard-object feeding in mangabeys.

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Enamel thickness varies significantly across primates. Understanding its sources of variation is important since enamel thickness provides both taxonomic and functional information. The Old World monkeys commonly known as mangabeys have figured prominently in investigations of feeding ecology and enamel thickness. Here, we report novel absolute and

relative enamel thickness values for four mangabey taxa (*Cercocebus atys*, *C. torquatus*, *Lophocebus aterrimus* and *L. albigena*), test the association between enamel thickness and durophagy, and offer revised interpretation of its significance in papionin evolution.

Our data indicate that thick enamel characterizes every mangabey species from both papionin clades sampled and that these values equal or exceed published values for other extant primates. In addition, new field data - combined with a current reading of the dietary literature - indicate that hard foods are included in the diets of every mangabey species sampled to date.

We conclude that (1) mangabeys from both clades have converged on a diet that includes at least some hard objects, (2) that they share some (thick enamel) but not all (expanded premolars) dental adaptations for processing obdurate foods, and that (3) their M_2 enamel thickness values are among the highest of all primates. Whether thick enamel generally is an evolved response to the material properties of foods consumed during "fallback episodes" or to foods consumed year round remains to be determined; however, these data argue for the latter scenario in that at least one mangabey species (*C. atys*) routinely processes very hard foods throughout the year.

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The way of all flesh? 'The other faunivory' revisited.

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Ten years ago, I sought to explore the possible role of invertebrates in the diets of extinct hominins, proposing some tentative modelling based on the foraging and diet of living nonhuman primates, especially hominoids. Subtopics that were raised included various modes of insectivory (or entomophagy), taxonomic contrasts across the Order Primates, the role of technology in harvesting prey, sex differences, and ethnographic comparisons with living *Homo sapiens* in traditional societies. Here I update and expand that approach, including new findings on: Ecological details of predator-prey relations between primates and insects; similarly detailed analyses of the nutritive content of invertebrate dietary components; cognitive, developmental and social learning processes involved in the acquisition and performance of insectivory; insights into the role of elementary extractive technology, including lithics; cultural transmission of exploitative skills and techniques; key role of an animal product, honey, as a universally-prized foodstuff, for both humans and apes. Some tests of proposed hypotheses have fared better (microwear, stable isotope) than others (coprolite, residue). Much research remains to be done, and crucial aspects of the 'other faunivory' remain to be clarified.

Microstructural analysis of linear enamel hypoplasia and estimation of stress episode duration in Jomon period dental remains

from Hokkaido with comparisons to other cold-adapted foragers.

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This study uses measurements and counts of the incremental microstructures of enamel (perikymata) to identify linear enamel hypoplasia (LEH) defects and estimate stress episode duration among Jomon period (ca. 5000 through 2000 BP) foragers from Hokkaido (HKJ). Results are compared with previously derived stress episode duration estimates among other cold-adapted foragers, specifically Neandertals from Europe and Inuit from Point Hope, Alaska. Each HKJ tooth was observed under a high resolution microscope. Perikymata spacing and enamel surface profiles were measured using VisionGauge software. LEH defects were identified according to accentuated perikymata and enamel surface depressions. All LEH defects were matched at chronological locations between teeth. Stress episode duration was estimated by multiplying the number of accentuated perikymata within each LEH defect by 8 and 7.4, representing the modal and mean periodicities for long-period striae in modern humans and Neandertals respectively. Box plots compared stress episode duration between the samples. The interquartile ranges for stress episode duration overlap in all three samples. Mean stress episode duration among the HKJ is reduced compared to the Point Hope Inuit and similar to mean stress episode duration among the European Neandertals. This suggests similarity in the distribution of stress episode duration between the HKJ and comparative groups, yet reduced average stress episode duration in the HKJ compared to Inuit sample. The results are consistent with greater availability of fall-back and complementary foods among the HKJ compared to Point Hope Inuit and similar availability/provisioning of these resources between the HKJ and European Neandertal samples.

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Differences in urinary progesterone metabolites levels in two populations of perimenopausal women in Argentina: Early developmental effects?

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The variation in women's reproductive hormone levels between and within populations is remarkable. Part of this variation can be

explained by current local ecologies, but it is becoming increasingly evident that hormone levels may be set very early during development in response to environmental cues. The goal of this study was to evaluate luteal progesterone levels in two populations that live in the same geographic region but differ in genetic, socioeconomic, and lifestyle background. These populations have clear-cut differences in developmental and lifestyle histories.

We sampled two populations of perimenopausal women (age >40, n=60) in Formosa, Argentina. The Toba are an indigenous population that has recently undergone a transition from a hunter-gatherer lifestyle to a peri-urban settlement. The other population draws from women of relatively high SES neighborhoods in Formosa capital.

We collected anthropometric, lifestyle and reproductive history data. We also collected urine samples every-other-day for two consecutive cycles for each of the participants. Samples were analyzed for PdG using enzyme-immunoassays. Women in both groups were well-nourished and showed similar BMI values (Toba: 31.2 ± 6.0 kg/m²; Non-indigenous: 28.6 ± 5.3 kg/m²). With few exceptions, both groups can be characterized as sedentary. Toba women showed lower PdG baseline levels and luteal PdG peaks of lesser magnitude compared to non-indigenous women. However, there was no significant difference in maximum luteal PdG values between the groups.

These results seem to support the hypothesis that local ecologies, particularly those of early developmental years, help set reproductive hormone levels later in adulthood.

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Evidence for long-term gene flow on the Balkan Peninsula using dental nonmetric data: identity at the Greek colony of Apollonia, Albania.

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We test the hypothesis that a sustained history of economic interaction throughout the Mediterranean resulted in long-term gene flow between Greeks and Illyrians that can be observed at the Greek colony of Apollonia, Albania (established c. 600 BC). This pattern of human biological interaction is tested by identifying variation in genetic relatedness using biodistance analysis of dental nonmetric traits for three localities: Apollonia (n=226), the mother-city Corinth (n=85), and Lofkënd (n=143), an inland site near Apollonia predating colonization. Dental nonmetric traits were recorded using the ASU Dental Anthropology System.

Logistic regression analysis was used to estimate differences between Corinthian and Illyrian samples and classified 90% of individuals from Apollonia with the Illyrian sample. This suggests that there was an Illyrian contribution to the gene pool at the Corinthian colony of Apollonia. Pseudo-Mahalanobis D²

statistics reveal greater phenetic similarity between colonial Apollonia and prehistoric Illyrian populations (including prehistoric Apollonia and Lofkënd), than with Corinth. However, small biological distances between all of the study populations suggest homogeneity between both the Illyrian and Greek populations. This homogeneous biological signature may represent long-term gene flow in the Balkans. However, the impact of incomplete skeletal remains and resulting small sample sizes must also be considered.

Although each Mediterranean community held a unique set of cultural norms and practices, all Mediterranean cultures shared certain features that come from a long history of economic interactions. This overarching cultural identity is termed Mediterraneanization. The broader implications of Mediterraneanization on biological identity and population diversity will be discussed.

This research was supported by a Fulbright U.S. Student Grant, a Sigma Xi Grant-in-Aid of Research, and the International Centre for Albanian Archaeology.

***PRLR* sequence diversity in owl monkeys (*Aotus azarai*) and other paternal care-giving primates suggests the maintenance of variation by balancing selection.**

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Numerous vertebrate studies have demonstrated a correlation between elevated levels of the pituitary hormone prolactin (PRL) in fathers compared to non-fathers. Knockout mouse studies have further implicated the prolactin receptor (*PRLR*), as a key component of this neuroendocrine pathway, which is associated with parental care behavior. Although paternal care is rare in the mammalian world, several platyrrhine primate taxa show high levels of paternal investment in offspring. In our study population, Azara's owl monkeys (*Aotus azarai*) of northern Argentina, males exhibit extraordinarily high levels of care to infants residing within their social group. Thus, to explore the nexus between *PRLR* variation and paternal care behavior, we sequenced the entire *PRLR* gene and characterized intraspecific variation in 25 owl monkeys. In addition, we examined interspecific variation in *PRLR* by sequencing the locus in four phylogeographically diverse *Aotus* species, as well as 12 other platyrrhine and catarrhine taxa who contribute varying amounts of paternal care to their putative offspring. Our analysis revealed that the coding region of *PRLR* exhibits high levels of variation within the *A. azarai* population, the genus *Aotus* possesses unique lineage-specific amino acid changes, and the gene displays considerable variation among both platyrrhines and catarrhines. In fact, entire codons within *PRLR* have been deleted in several species. We further detected signatures of balancing selection that have maintained molecular diversity in the intracellular domain of *PRLR* mRNA. These findings suggests that functional changes in

PRLR may have contributed to the uneven distribution of paternal care behaviors among extant primates

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Obtaining quantitative life history predictions from serial growth data.

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Although qualitative predictions of life history theories are often used for hypothesis testing, some research may benefit from quantitative predictions. This study focused specifically on how to operationalize a simple version of the power-function growth model for optimal age and size at maturity. In addition to briefly describing the properties of the model, equations will be introduced for predicting individual-level (1) adult mortality, (2) size-dependent production rate, and (3) growth subsidies / provisioning, from data on serial growth and maturation, or vice-versa. An Excel template for easy implementation of these equations will also be presented.

An example is presented testing the hypothesis that father absence results in earlier menarche by serving as a "socioassay" of high mortality levels. Theoretical predictions of mortality were generated in a sample of 826 female participants of the California Child Health and Development Studies, based on individual growth data. Participants from families with parental separation or other marital worries prior to age 10, but not economic worries, had significantly earlier reported menarche than those from families reporting either economic problems or neither economic nor marital problems (KW $\chi^2=8.1$, d.f.=3, $p=0.043$). However, this group did not have significantly different life history predictions for adult mortality, and the trend was in the opposite direction. The results suggest that father absence and marital problems do not serve as a socioassay for expected mortality conditions as currently understood in life history theory.

Potential influences of infant sleeping arrangement (social or solitary) in the developmental trajectories and life history strategy of adults.

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Our previous cross-sectional studies of breastfeeding solitary and co-sleeping mother-infant pairs revealed significant differences including, for co-sleeping dyads, more frequent breastfeeds, enhanced mutual sensitivities, communication, face-to-face body orientations, and sleep stage synchronicity. Cross-cultural and cross-species data, and understandings derived from evolutionary models suggest that mother-

infant co-sleeping is the species-wide norm, although due to recent historical and social factors in the US and most European societies infants sleeping in isolation became common. Although long-term empirical studies are necessary to fully elucidate whether or if solitary sleep and co-sleeping influence differential developmental trajectories during infancy, indirect evidence suggests that young children who co-sleep are perceived by their teachers to exhibit better comportment, and may enjoy stronger attachments, exhibit more control over their emotions. Late teens who coslept as children report more comfort with their gender identities and with physical intimacy, while older adults describe themselves as optimistic and appear less likely to accept an uncritical "collectivist" cultural mentality. Research elsewhere has shown that some of these factors influence adult reproductive and relational behaviors that comprise components of life history strategy, such as attachment profiles with offspring and attendant parenting commitments, the likelihood of promiscuity, divorce, and psychological resilience. As a consequence, it is conjectured that familial sleeping arrangements during infancy and the effects thereof are one example of the ways in which the culturally constructed social milieu can influence developmental trajectories with implications for reproductive behavior and life history strategy in adulthood, independent of energetic status.

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Does "The Extrinsic Risk Hypothesis" explain cross-cultural variation in age at introduction of transitional foods?

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Mothers in different human populations vary substantially in when they begin introducing non-breastmilk liquids and solids to their infants' diets, but we do not fully understand why the variation evolved.

One hypothesis holds that mothers adjust their parental investment strategy in response to level of extrinsic risk. This hypothesis assumes mothers focus on offspring *quality* in low risk environments but concentrate on offspring *quantity* in higher risk environments and that weaning represents reduced maternal investment in an individual child. It predicts an inverse quadratic relationship between age at introduction of "transitional" foods and level of risk: mothers introduce transitional foods later as risk increases from low to moderate levels and then earlier as risk increases from moderate to high levels.

We tested the risk hypothesis using ethnohistoric data from 38 natural fertility farming and herding populations. We regressed age at introduction of transitional foods on three proxies of risk: subsistence risk, pathogenesis, and infant mortality. We found that introduction

of transitional foods is positively rather than inversely quadratically correlated with subsistence risk. The relationship between transitional foods and pathogen risk is negative and linear. Transitional foods are not correlated with infant mortality. Thus, none of our analyses supports the risk hypothesis as currently formulated.

Although the relationships do not follow the predictions of the risk hypothesis, our findings suggest age at introduction of transitional foods covaries with extrinsic risks. These results raise questions about whether introducing non-breastmilk foods represents a shift in form rather than a reduction in maternal investment.

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New morphological diagnoses and specimen attributions of the Kisingiri *Proconsul* species, *P. nyanzae* and *P. heseloni*.

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The early Miocene primate *Proconsul* is one of the best represented catarrhines in the fossil record. Among the several species attributed to this genus, those from the Kisingiri localities of Rusinga and Mfangano Islands – *P. nyanzae* and *P. heseloni* – are known from the largest samples. Nevertheless, there has been little documentation of the morphological features that distinguish between these two species. When *P. heseloni* was named (Walker et al. 1993), no differential diagnosis with *P. nyanzae* was given, although it was implied that *P. nyanzae* is substantially larger, and only four enumerated craniodental specimens were assigned to *P. heseloni*. Further, despite a large number of canines preserved in the overall sample, including some in associated specimens, studies that recognize two species of Kisingiri *Proconsul* have consistently failed to identify female specimens of the larger *P. nyanzae*. Here, we report results of an analysis of the cranial, mandibular, and dental variation in the Kisingiri *Proconsul* sample. Our study adds substantially to the number of characters by which *P. nyanzae* and *P. heseloni* can be distinguished, and results in revised and expanded hypodigms for both species. We also make some important changes in specimen attributions. For example, the iconic KNM-RU 7290 (“Mary’s skull”) is identified as a *P. nyanzae* female. These revised hypodigms extend the range of metric variation in both species, suggest more overlap in their inferred body sizes, and result in a more balanced representation of males and females.

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Changes in postcranial morphology in modern American Whites.

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Secular change in stature and long bone lengths has been documented for the American population. In more recent years these trends have slowed or stopped altogether. This paper will examine secular trends in postcranial robusticity, shape of long bone shafts, and limb proportions. Data derived from the Terry Collection, the University of Tennessee Donated Collection and the Forensic Anthropology Databank. These individuals collectively have dates of birth from the 1840’s through 1980. Long bone lengths and shaft diameters of males and females, specifically, brachial and crural indices, and indices of robusticity and midshaft shape were examined. Analysis of variance using these dimensions by birth decade means reveals a trend towards gracilization, most pronounced in the femur. Tibiae become relatively longer over time, as shown by the crural index, and femur midshafts become relatively more anterior-posterior elongated. The brachial index in females reveals no consistent pattern, while males evidence a significant increase over time. Lengths of the humerus, radius and femur do not change significantly over time, however the tibia does exhibit significant increase for both males and females. Genetics and environmental factors play roles in how skeletal changes have occurred over time. While improvements in health care and nutrition have long been used to account for the secular changes in stature and bone lengths, marked differences in lifestyle likely play a role in the gracilization of postcranial elements.

Cooperative breeding, child health, and growth among the Aka foragers.

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The Cooperative Breeding Hypothesis argues that human mothers’ short inter-birth intervals, high fertility, simultaneous multiple dependent offspring, and competing demands on their effort expenditure made non-maternal caregivers (allomothers) necessary in our evolutionary past and in contemporary small-scale societies today. Among foragers, children are cared for and provisioned by multiple caregivers, occupying both kin and non-kin relational categories. However, there is variation in who assists, how many individuals cooperate, and the frequency of care offered to particular children. This paper explores the roles of mothers and allomothers in the lives of Aka tropical forest forager infants and young children in the Central African Republic. Specifically, I test a component of the Cooperative Breeding Hypothesis, which states that human childrearing networks should be flexible—multiple caregivers

(beyond fathers and grandmothers) can and do fulfill essential roles in childrearing. Caregiving patterns, health, and anthropometric data were collected on 40 Aka children (birth-3 years) through detail quantitative behavioral observations (approximately 500 hours), qualitative ethnographic data, and basic health exams. Resultant data demonstrate, in support of the Cooperative Breeding Hypothesis, that the size of a child’s caregiving network, rather than the presence of one or two particular caregivers, has significant positive effects on child growth and health as children move through infancy into childhood. This multifaceted approach to understanding childrearing enables the role of caregivers in the experiences and development of children to be explored while shedding light on what may have been necessary to rear children in our evolutionary past.

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Anatomical configuration of the *Australopithecus afarensis* shoulder: evidence from a new clavicle (KSD-VP-1/1f).

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The evolutionary descent of the shoulder is proposed to have occurred after or with the evolution of *Homo*. Unfortunately, the previously known sample of *Australopithecus* clavicles did not preserve many distinguishing anatomical features. The partial skeleton KSD-VP-1/1, recently discovered at Woranso-Mille (Afar, Ethiopia), preserves the most complete adult clavicle assigned to *Australopithecus afarensis*. Clavicle length, torsion and curvature are thought to indicate scapula position, shoulder width and/or shoulder height, but no consensus exists regarding the anatomical implications of morphology preserved in the *Australopithecus* sample. I used a combination of Geometric Morphometric and traditional comparative methods to describe morphological variation in the living apes and *Australopithecus*.

The curvature of the human clavicle is distinctive among living apes. With the preservation of the medial shaft, KSD-VP-1/1f demonstrates human-like curvature for the first time in *Au. afarensis*. Although KSD-VP-1/1f falls comfortably within the range of human clavicle length and torsion, more information is needed in order to reconstruct shoulder configuration. Torsion is thought to reflect overhead use of the arms, but this character does not vary in a functionally informative manner within the apes.

The shoulder is a complicated joint complex with many constituent parts, making functional inference from isolated elements difficult. Vital regions are still missing from the fossil sample, but the data emerging from the study of the KSD-VP-1/1 partial skeleton suggest a unique configuration of the *Au. afarensis* shoulder that is more like that of modern humans than has been previously proposed.

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Seasonal variation in capuchin insectivory and invertebrate abundance.

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Invertebrates provide a critical source of dietary protein for human and non-human primates. In tropical forests, seasonal variation in food abundance presents obstacles for food acquisition and influences foraging patterns. Fluctuations in fruit abundance and consumption have been well documented, yet less is known of variation in insectivory. We studied the effects of rainfall and temperature variation on invertebrate abundance and consumption by Costa Rican capuchin monkeys (*Cebus capucinus*). From 2003-2011 we studied four free-ranging groups of capuchins in Sector Santa Rosa, Guanacaste. We quantified invertebrate consumption via primate behavioral observations and invertebrate abundance via arboreal and terrestrial sampling techniques. The peak in invertebrate consumption coincided with the onset of the rainy season and was primarily driven by dramatic increases in caterpillar populations. A trough in invertebrate consumption occurred with heavier rainfall and cooler temperatures. During the dry season, invertebrates were eaten in moderate amounts. At this time of year, consumption of large mobile (i.e., katydids, cockroaches) and embedded (i.e., termites, grubs) invertebrates increased. We suggest that the capuchins at our study site prefer caterpillars when they become available in the early rainy season, and bias their diet to reflect this. When available, caterpillars may be the most profitable invertebrates to target because they are harvested quickly and require shorter handling and processing times than other invertebrate types. Capuchins focus on more difficult-to-obtain invertebrates in the dry season when caterpillars are not available. Seasonal variation in invertebrate abundance has important implications for capuchin foraging energetics and food acquisition strategies.

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Chewing on something new: an experimental model for primate dietary variability.

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The evolution and function of the human skull and feeding apparatus is intimately related to the mechanical demands imposed by food items. Primate dietary resources may often be seasonal, resulting in the consumption of non-preferred, difficult-to-process "fallback foods." Indeed, seasonality is invoked in ecological interpretations of fossil hominins (e.g., *Paranthropus*). Despite the temporal complexity of primate diets, little work exists related to the long-term impact of variability of dietary properties on craniofacial development. This study uses a well-established experimental species, the laboratory rat, to model primate skull growth as affected by temporal shifts in dietary properties. Four dietary cohorts (n=10/cohort) were raised from weaning to skeletal maturity. Two cohorts were fed a stable diet of either solid or powdered pellets. The other two cohorts were fed a variable diet of either solid/powdered pellets for the first half of the study, followed by a shift to the opposite diet. *In-vivo* microCT imaging was used to quantify ontogenetic changes in craniofacial morphology. Skeletal growth rates were assessed via fluorochrome labeling, and serological markers related to skeletal physiology were analyzed across the growth period. Results describe patterns of morphological variation and covariation in the mammalian craniofacial complex related to temporal dietary variability. This experimental approach emphasizes the capacity of laboratory studies to generate longitudinal data at multiple organismal levels which compliment observational and comparative studies of primates. An enhanced understanding of the impact of dietary composition on craniofacial variation is critical for evaluating ecomorphological reconstructions of feeding behavior in living and fossil primates.

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Causal mechanisms of the development of scent-marking in *Lemur catta*: inferences from comparison of wild and captive settings.

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Where development in captivity does not mirror development in the wild, comparisons across settings can shed light on the proximate drivers of particular elements of behavioral development. Here, I compare the developmental timelines of specific aspects of the *Lemur catta* scent-marking behavioral suite documented in the captive literature with their developmental timelines generated from a sample of 37 immature individuals observed during 2008-2009 at Beza Mahafaly Special Reserve, Madagascar. In *Lemur catta*, both sexes mark substrates with secretions from their anogenital glands. Males also have brachial and

antebrachial scent glands and use their keratinous antebrachial spurs to gouge substrates and deposit these glandular secretions. Growth and sexual maturation in ring-tailed lemurs is greatly accelerated in captivity. The development of anogenital marking is also dramatically accelerated in captivity (13-16 months in captivity versus >24 months in the wild), but brachial and antebrachial marking are not. Instead, they appear at and persist after 12 months in captivity, nearly coincident with their final appearance at and persistence after 13 months in the wild. The timing of the onset of anogenital marking in both settings is consistent with previous suggestions that anogenital marking is driven by sexual maturation. In contrast, the invariant onset of juvenile antebrachial and brachial marking across wild and captive settings suggests that the development of these behaviors is independent of postnatal somatic and hormonal development and that *prenatal* hormonal and/or postnatal *social* cues are more likely to be causal factors.

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The influence of height and weight on adult skeletal age estimation.

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In all biological sciences, body size is a crucial variable in the analysis of biological traits, yet in the assessment of adult human skeletal age the influence of body size has received little attention. The most reliable and frequently used age estimation methods are based on pelvic morphology, where loads vary with body weight during life; however, any influence of body height and weight on skeletal age changes remains undetermined. This study assessed age from weight-bearing and non-weight-bearing bone surfaces in skeletons of individuals with known heights and weights at death.

Eight age estimation methods were applied to over 500 skeletons from the Hamann-Todd Collection at the Cleveland Museum of Natural History. Individuals ranged in size from 5'1" to 6'3" and 82lbs to 220lbs. The pubic symphysis, auricular surface, sacrum, and acetabulum represented the weight-bearing joints; the first and fourth ribs represented the non-weight-bearing joints. Inaccuracy and bias were calculated for each method and tested for significance. When height is controlled, individuals in the lightest and heaviest weight categories tend to be under-aged more often while individuals in the middle categories have more variable age trends. The comparison of individuals with differing heights and weights to age suggests that there are age-related patterns. Among the sites tested, the ribs and pubic symphysis tend towards under-aging, while Buckberry and Chamberlain's auricular surface method tends towards over-aging. The over-aging of individuals in the lightest and heaviest weight categories may indicate that lifestyle and activity are important in age estimation.

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Functional anatomy of the thoracic vertebrae in early *Homo*.

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Several features of the human thoracic vertebrae confer greater flexibility, load bearing, and neurological capacity than is seen in australopithecines and apes. The Dmanisi and Nariokotome fossil vertebrae provide a window into the evolution of these features in early genus *Homo*.

The thoracic articular complex in early *Homo* differs somewhat from modern humans, with a small articular facet size and more horizontal orientation that would have allowed more physiologic motion in the sagittal plane. Short laminae as the posterior component of the articular functional complex in the upper thoracic region may have also contributed to an increased range of movement in the sagittal plane, allowing more freedom in the incidence of vertebral imbrication. Thus, *Homo erectus* appears to have a slightly more flexible thoracic spine than is seen in humans, australopithecines and especially the apes. Vertebral bodies in the Dmanisi *Homo erectus* differ from earlier hominids and apes in their configuration to bear forces from vertical and anterior load vectors. The size of the spinal cord in the Dmanisi hominid is fully modern in contrast to Nariokotome.

Taken as a functional whole, the thoracic region in early *Homo* is typical of the derived human morpho-functional complex, and possesses the anatomical hallmarks of modern erect posture and a modern sized thoracic spinal cord.

The functional morphology of the hominoid fibula.

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In the past, the fibula has been overlooked in comparative studies due to the scarce chance of preservation of a thin bone and the poor involvement in supporting the weight of the human body. However, the fibula serves as an important origin for some muscles of the lower leg.

The aim of this study was to look for differences in the origin and insertion of *m. peroneus longus* which can provide new insights into the degeneration of the great toe in humans and orangutans during evolution. This is especially interesting since there is still an ongoing debate if australopithecines and early *Homo* possessed human-like feet with adducted great toes or ape-like feet with opposable halluces.

Fibulae of chimpanzees, orangutans, macaques and modern humans were morphologically compared to the fossilized fibular fragments of Stw 356 (*Au. africanus*) and OH 35 (*H. habilis*). Dissections of the lower leg

and foot of the previously mentioned primates were performed to obtain precise information about the origin, insertion and function of the muscles with special attention given to muscles with insertions upon the hallux.

The obtained results indicate that the studied fossils morphologically show a more human-like pattern. No significant differences concerning the origin, insertion, gross morphology and weight proportion of *m. peroneus longus* in the ape specimen were recognizable. The single exception is that the insertion of *m. peroneus longus* differs in humans.

3D reconstruction of Regourdou 1 pelvis: estimation of missing parts and first morphometric analysis.

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The Regourdou 1 pelvis is a newly discovered and described neandertalian pelvis. It bears us new opportunities to discuss numerous aspects of the morphology of the neandertalian pelvic belt, as locomotion and especially obstetrical functions. Because of the bones' state of preservation, with missing parts and damaged structures, the Regourdou 1 pelvis has to be reconstructed to allow further studies.

Acquisition of Regourdou 1 pelvis' CT-scans was performed with helical computed tomography; 54 landmarks were defined, in the light of our subsequent analyze of Regourdou 1 obstetrical dimensions. These landmarks have been collected using the software TIVMI from a comparative sample of 100 modern and 2 neandertalian (Kebara 2 and Feldhofer 1) virtual pelvises; then, the landmarks available were taken on Regourdou 1 pelvis. Three estimations of the missing landmarks of Regourdou 1 were realized, with three different estimation's methods: a multiple regression method, the EM algorithm and the Thin-Plate Spline; the choice between these three reconstitutions was made under different criteria (mean error, intra-specific reconstruction). The statistical comparison of these three methods and the estimation of Regourdou 1 missing parts were performed using R software. This mathematical reconstruction is a first step to a triangular mesh generation and finally a 3D printed replication.

The 3D reconstruction of Regourdou 1 allows us to propose an estimation of obstetrical dimensions. The comparison of these dimensions, on one hand to the neandertalian and modern variability, on the other hand to newborns' cranial data, brings us new information on the evolution of obstetrical function.

The pendular movement in brachiation: a simple model for a locomotion system used in complex environments.

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Gibbons are known to brachiate using a pendular mechanism, which is thought to be very energy efficient in controlled conditions. However, little is known about how these animals react biomechanically to an unpredictable, complex environment, such as the rainforest they live in. So far, how robust brachiation efficiency is with respect to support compliance has not been tested.

We carry out a kinematic and kinetic comparison (in captivity) of two siamangs, using two setups, to investigate the effect of a compliant branch on gibbon locomotion. Both setups are identical with handholds at the same level, 1.2 m apart and the three middle handholds equipped with force transducers. However, one setup has all fixed handholds, while the other one has a spring-like handhold in the middle. In total, 30 sequences were analyzed.

Preliminary results lead us to think there are two strategies to cope with the compliant handhold (com). One animal uses only ricochet brachiation and although the spring is not skipped, very little force is executed on it. However, judging by the com pattern, it seems the spring is ignored and not used to redirect the com, nor does it affect its position. The other animal brachiates over the spring using slow continuous contact brachiation. Under its weight, the spring elongates, yet the com does not always follow this elongation.

Comparison of energy exchange, collision reduction, forces, and joint angles on these two setups and between the two strategies will enable us to understand how animals cope with their complex environments.

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Dietary, behavioral, and hormonal comparisons of female red colobus monkeys (*Procolobus rufomitratu*) in logged and unlogged areas of Kibale National Park, Uganda.

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Examining the response of wild primate populations to habitat disturbances is essential for understanding the impacts on and potential adaptive abilities of species to adjust to environmental change. This study investigates differences in the behaviors, diets, and hormone profiles of female red colobus monkeys (*Procolobus rufomitratu*) living in logged and unlogged areas of Kibale National Park, Uganda. Our three main objectives were to determine: 1) differences in activity budgets and mating behaviors between logged and unlogged areas, 2) how habitat differences impact diet, and 3) the relationship between habitat quality and hormone profiles. Focal follows of 40 females in 6 groups of red colobus (3 in logged and 3 in unlogged

areas) resulted in approximately 7000 hours of observation time. Fecal samples (n=600) were collected and analyzed using radioimmunoassays to determine hormone concentrations. Females in logged areas spent significantly more time feeding and significantly less time resting, traveling, and grooming than females in unlogged areas. Females in logged areas had lower rates of copulation and constrained sexual activity to periods of maximum swelling compared to females in unlogged areas. Diets differed significantly – females in logged areas had a more diverse diet than females in unlogged areas, which ate larger quantities of select tree species. Despite these behavioral and dietary differences, hormone profiles did not differ between logged and unlogged areas of Kibale National Park. Determining how habitat quality impacts primate populations is crucial for the management of wild primate populations and has important implications for the study of phenotypic plasticity.

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Swing phase period in primates and other mammals: influences of speed and limb design.

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Primates and other mammals display remarkable diversity in limb design (length, mass, and weight distribution), which has profound implications for how limbs move during locomotion. While many studies have focused on stance phase mechanics, swing phase has been overlooked. The rate of swing and required muscular effort, which are influenced by pendulum length and mass, can affect energetic costs and speed. It is assumed that as speed increases stance period decreases, while swing period stays relatively constant. In effect, limb inertial properties may constrain the swing period, which is especially relevant for primates as prehensile hands and feet may contribute to heavier limbs more distally. By calculating swing period in three carnivorans and a wide range of primate species, we test the hypotheses that: (1) swing phase period stays constant as speed increases, and (2) primates have relatively longer swing periods compared to other mammals. Results from our sample show that stance period decreases as speed increases, while swing period remains nearly constant in each species examined. Lemurs and kinkajous had relatively longer swing periods compared to cats, while *Saimiri* had relatively short swing periods compared to other primates. These data suggest that swing phase period is constrained by limb design and that in some arboreal mammals, the need for decreasing swing period must be balanced by other factors such as longer limbs and more distally positioned musculature. These competing factors must be understood for

accurate interpretations of limb anatomy in living and fossil mammals.

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Genetic analysis of ancient *Mycobacterium tuberculosis* complex DNA from Precolumbian Late Woodland and Mississippian sites in the lower Illinois River Valley.

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We have identified *Mycobacterium tuberculosis* complex (MTC) DNA in individuals from the Late Woodland (LW) period at Schild and Yokem Mounds as well as the Mississippian period at Yokem. The three individuals from the LW Mound 1 at Schild are among the earliest cases of tuberculosis identified through the use of ancient DNA techniques in west-central Illinois. Previous studies have found MTC DNA in Mississippian individuals from Schild Cemetery. Fifty-eight individuals from Schild and Yokem Mounds were screened for the presence of MTC genes *gyrB*, *16s rRNA*, *pncA*, *oxyR*, and *hsp65* in addition to insertion sequences *IS6110* and *IS1081*. Partial *gyrB* sequences were amplified in Yokem individuals 1-18, 2-10, 2-11, 2-12, and 2-17, as well as Schild individuals 1-11, 1-17, and 1-24A. *IS1081* was amplified in Schild 1-17 and a partial sequence of the *16s rRNA* gene was amplified in Yokem 1-18. There were no pathognomic tuberculosis lesions in these individuals, but there is interesting evidence of systemic disease.

The source of MTC in the Americas remains unknown. It is generally suggested that tuberculosis was not present (or there was a very large increase in cases) in ancient North America until approximately AD 1000. We present data showing that the actual evolutionary history of the disease is not consistent with this interpretation. The data are more consistent with the hypothesis that the ancient MTC strain(s) presents differently than modern MTC strains and thus is not detected through gross paleopathology or is not visible as bone lesions.

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Disentangling human demographic processes? What mtDNA simulations teach us.

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Gene flow has played a defining role in the population structure of modern humans. The complexity of human demographic processes makes it difficult to disentangle the effects of gene flow from the effects of other demographic processes. To address this, we simulated mitochondrial DNA (mtDNA) for 42 different parameter combinations describing modern humans migrating out of Africa, which include

two possible times for the initial migration event, three sizes for the initial migrating population and seven levels of subsequent gene flow. We calculated genetic summary statistics on the simulated datasets to capture the genetic variation of each combination. We compared the summary statistics values to identify which combinations generate distinguishable differences in genetic variation. Depending on the parameter combination, one to four summary statistics could capture differences in genetic variation. Our results show that different timings for the migration (2000 vs. 4000 generations ago) generated indistinguishable patterns of genetic variation. Combinations with low initial migration size (1% of the source population) generated distinguishably different patterns of genetic variation from the higher initial sizes (10% and 30%). The genetic variation from the different levels of gene flow were only distinguishable between low (4Nm<1) and high (4Nm>>1) levels of gene flow. These results suggest that despite the complexity of human demographic processes, the genetic variation of mtDNA generated in human populations is not high enough to be captured by simple summary statistics.

Bone microstructure and behaviour in “gracile” and “robust” adult males from the Medieval Period, Canterbury, UK.

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Different types of activity can affect the morphology and strength of limb bones. This bone functional adaptation means that aspects of behaviour can be inferred in archaeological samples of modern humans. One popular methodological approach is to examine muscle attachment sites. However, this technique can be subjective. An alternative approach is to analyze bone microstructure. This latter method is more objective, because histological units directly linked to bone growth can be quantified. Here, we seek differences in bone microstructure between twenty age-matched adult ‘robust’ and ‘gracile’ male skeletons dated to the British Medieval period.

Samples were selected based upon gross skeletal morphometry (37 bilateral postcranial measurements), muscle markers (55 bilateral postcranial sites), and femoral midshaft cross-section cortical thickness. Samples were then assigned as either ‘robust’ (n=10) or gracile (n=10). Following this, standard histological procedures were employed to produce thin sections of the posterior (P), anterior (A), lateral (L), and medial (M) femoral midshaft. Eight microscopic variables were compared between the groups.

Intact osteon density (P:p=.013), fragmentary osteon density (P and M:p=.002, L:p=.010), osteon population density (P:p=.002, M:p=.003), Haversian canal area (A:p=.016, P:p=.028, M:p=.005, L:p=.002), Haversian canal diameter (A:p=.010, P:p=.023, M:p=.002, L:p=.007), osteon area (A:p=.002, P:p=.034, M:p=.001, L:p=.010), and osteocyte lacunae density (A:p=.011, P:p=.006, M and L:p=.000) differed significantly between gracile and robust males. Results indicate faster remodelling rates

in robust individuals. Differences in behaviour are inferred between the two groups. A more active lifestyle involving excessive leg muscle use is inferred for the robust male group. Methodological suggestions are given.

A new method for measuring surface area of the infant anterior fontanelle utilizing CT data.

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The anterior fontanelle (AF) of the infant cranium is an integral element in growth of the craniofacial system, with variation in its size indicative of altered growth patterns. Traditionally, surface area of the AF in fetal and newborn crania has been estimated using linear measures of the longitudinal and transverse diameters. Although this method has the advantage of being applicable to both dry crania and digital image data, it does not provide an accurate measure for crania with irregularly-shaped fontanelles. Additionally, this method assumes the AF borders to be smooth curves, while naturally-occurring undulations may be present due to variable rates of bone deposition. In this study we test a new method of estimating AF surface area (AFSA).

Our sample consisted of CT data of cadaveric human fetal crania between 30-36 weeks gestation (N=5). Three-dimensional surfaces of the crania were reconstructed using Amira 5.2©. We collected longitudinal and transverse diameters of the AF. We also calculated AFSA from the 3D cranial surface reconstructions through labeling of individual voxels of the CT images. We then statistically compared the two measures of AFSA.

Results show that the two estimates of AFSA are statistically significantly different. We hypothesize that the differences are the result of the highly variable shape of the AF, which cannot be taken into account by the traditional measures. Thus, this novel method of estimating AFSA may be more accurate, particularly when the fontanelle is irregularly shaped, due either to natural variation or pathology in bone deposition.

Metameric variation in the expression of the interconulus in *Papio* and *Macaca*.

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The interconulus is a trait that expresses between the protocone and hypocone of the maxillary molars in populations of *Papio* and *Macaca*. The interconulus is a continuously varying trait that ranges in expression from a lingual groove to a pronounced cingulum. Hlusko's (2002) study found that the interconulus in a population of *Papio hamadryas* from the Southwest National Primate Research Center has increasing expression from M1 to M3, an example of metameric variation. Our new

study examined the molars of *Papio* (n=42) and *Macaca* (n=136) individuals from three museum skeletal collections for variation in the expression of the interconulus. Because the interconulus is a continuously varying trait, a standard of five discrete categories of expression (score 1-5; Hlusko 2002) was used to quantify the trait. The *Papio* individuals did not demonstrate statistically significant metameric variation in the expression of the interconulus. However, the *Macaca* sample did demonstrate significant metameric variation with mean scores of M1=1.12, M2=1.47 and M3=1.75. Assessment of mean expression scores at the species and subspecies level suggests that ordered metameric variation may occur in some taxonomic units and not others. Metameric variation is found in numerous parts of the metazoan body plan, from body segments, to sets of appendages, to the vertebral column. Our project aims to characterize the metameric variation seen in the Old World Monkey dentition, ultimately contributing to a more general understanding of the role that metameric variation has played and continues to play in primate evolution.

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Population genetics, dispersal and kinship among two social groups of squirrel monkeys (*Saimiri sciureus*).

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Observational studies of squirrel monkeys (*Saimiri*) have documented instances of intragroup transfer for both males and females, depending on the species and the local ecology. Measurements of genetic relatedness among individuals are useful for testing predictions regarding the evolution of kin-biased social behaviors, sex-biased dispersal patterns and various fitness outcomes for adult group members following reproductive behaviors. Still, little genetic information is available to support hypotheses surrounding the ecological and social parameters that may affect the population structure and dispersal outcomes within such variable social systems of *Saimiri*. Here, we use genetic data to assess kin structure within social groups among a wild population of *Saimiri sciureus* at the Tiputini Biodiversity Station in eastern Ecuador; we also use these data to infer dispersal patterns and evaluate possible sex biases in dispersal. If there is greater male dispersal, then average pairwise relatedness, F_{ST} values, and intragroup mean corrected assignment indices among adult females should be greater than those among adult males. Adult females should also have a greater number of close kin members that are of the same age class and sex. Genomic template was extracted from fecal samples and fourteen loci were amplified for 62 unique individuals. Not only were the two social groups genetically distinct, as estimated by F_{ST} measurements, but average pairwise relatedness values and mean corrected

assignment indices were greater for females than males. This suggests that much of the gene flow is due to male dispersal and that females are the philopatric sex.

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Timelines in teeth: using micro-CT scans of partially mineralized human teeth to develop a new isotope sampling strategy.

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Isotope analysis of human dental enamel is used to study migration, diet and pollution. Enamel is resistant to diagenesis and because it does not remodel, it acts as an archive of the elements ingested from the diet as the tooth develops. However, the pattern of organic matrix deposition and initial crystal seeding which produces incremental features such as the lines of Retzius, does not necessarily reflect the pattern of mineralization of the tooth during the maturation phase, when the bulk of the mineral is incorporated into the apatite crystals within the enamel (Suga 1982 1989). Inter-tooth analysis extends the temporal range of information, but intra-tooth analysis is problematic because of the complex pattern and duration of mineralization in human teeth.

Micro-CT scans of permanent teeth at different stages of development from both archaeological and modern juveniles have been produced using SkyScan 1072 and 1173 high-resolution desk-top micro-CT systems. The pattern and progression of initial mineralization and maturation of incisors, canines, premolars and molars has been investigated using bone mineral density calibrated using phantoms and an aluminum tooth standard to address potential beam hardening artifacts.

Different tooth types show variation in the complexity and progression of maturation. Intra-enamel isotope profiles from individuals with known migratory or dietary changes during crown formation have been produced using laser ablation and micro-drilling following the maturation time-lines established from the CT-scanning results. The results suggest that choosing a tooth with a simple linear pattern of maturation significantly increases the potential of extracting time-related isotopic information.

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Understanding how sex and pathology affected frailty during the Amarna Period (BC 1351-1334).

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The motives behind Akhenaten's relocation of the religious and political capitals in Egypt to a remote and untouched stretch of desert during the early years of his reign are not well understood. Excavations of the South Tombs Cemetery since 2006 have provided a detailed look into the lives of the inhabitants that were uprooted and thrust into a challenging new habitat. The application of transition analysis has since revealed a mortality pattern that does not correspond to normal attritional models. The purpose of this study is to further investigate the differences in frailty between sexes. The sex ratio is divergent from a stable population, with females dying more frequently than males (1.24:1). This finding suggests that some factor contributes to an increased risk of death among females in the sample. Examination of the differential risks of dying at Amarna used a proportional hazards model to test how different pathological conditions (cribra orbitalia, porotic hyperostosis, and periostitis) affected the risk of death for men and women. A Likelihood Ratio Test ($p < 0.001$) confirms the notion that non-specific indicators of stress created an unequal risk of death between men and women. However, an examination of burial treatments and patterns among males and females show no major variations. The results of this study show that unique factors affected the frailty of men and women in different periods of their lives, but ancient understanding of these factors may not have been perceived and, thus, did not influence burial treatments.

Meta-analysis of forensic stature estimation.

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Accurate stature estimation relies on population, age, sex and generation specific formulae due to varying body proportions worldwide. The goal of this research project is a global meta-analysis of stature estimation. A survey of more than sixty recent publications reveals the current state of stature estimation; what populations have been studied and what populations require data collection and/or analysis. This paper also reviews the estimated number of missing persons for different regions.

Of the publications reviewed, the most accurate predictors of stature continue to be the femur and tibia. The coefficient of correlation for which ranges from 0.82 to 0.93 and SEE of 2.4-4.0 for both males and females. Thirty of the studies compare the long bones of the upper and lower limbs. Fifteen of the studies compare the measurements of the hand or feet (fleshed, radiographic, tarsals or metacarpals/metatarsals). The vertebrae are the next most commonly compared elements to stature. A handful of the studies look at measurements of the cranium, face or dentition, but with little success ($r < .06$, SEE > 5.0). The cranial sutures had the lowest coefficient of correlation (.09-.363). Multiple regression yields higher results than simple linear regression. Stature formulae for males tend

to have higher correlations than those for females.

The regions that have the highest number of stature formulae for the populations represented are North America, Eastern Europe, West and South Asia and Southern Africa. Areas that would benefit the most from new stature estimation include South America, North and Central Africa and Southeast Asia.

The Patterning Cascade Model and expression of the Carabelli feature in humans: differences between first and second molars and correlation with other dental traits.

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The Patterning Cascade Model of tooth morphogenesis has emerged as a powerful tool in explaining how tooth shape develops and how tooth evolution may occur. Enamel knots, specialized areas of dental epithelium from which cusps initiate, act as signaling centers that direct the growth of surrounding tissues. For a new cusp to form, an enamel knot must form beyond the inhibition fields of other enamel knots. Because of this effect, the model predicts that the number and size of cusps depends on the spacing between enamel knots, reflected in the spacing between cusps. Recently work by our group on Carabelli trait in humans demonstrated that the model predicted Carabelli expression in first molars. Here we test whether differences in Carabelli expression along the molar row can also be predicted by the model. Crown areas and intercuspal distances were measured three times for each M1 and M2 from dental casts of 380 individuals with a digital microscope. Although absolute cusp spacing is similar in M1s and M2s, the smaller size and more triangular shape of M2s results in larger cusp spacing relative to size and, likely, less opportunity for Carabelli to form. The presence and size of the hypocone and a range of small accessory cusps were also found to covary with the Carabelli feature and thus with cusp spacing. The results of this study lend further support to the view that dental cusps are not independent of each other and that teeth develop, vary, and evolve as single functional complexes.

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Phylogenetic relationships, biogeography, and taxonomy of spider monkeys (*Ateles sp.*).

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Spider monkeys (genus *Ateles*) are widely distributed from Mexico to northern Bolivia and include many allopatric forms with morphologically distinct pelage coloration and patterning. The taxonomy, phylogenetic relationships, and biogeographic history of the genus have been subject of much debate. We explored the genetic relationships among the different forms of spider monkeys using ~3.9 kb of sequence data from the ND5, ND6 and Cyt b genes of the mitochondrion for seven putative species of *Ateles*, using *Callicebus* and *Alouatta* as outgroups. Maximum Likelihood and Bayesian reconstructions, recovered identical tree topologies with high statistical support. All putative species for which more than one sample was available formed monophyletic lineages, and *A. marginatus* was identified as the first taxon to branch off within the *Ateles* clade. Using BEAST, we inferred that all species of *Ateles* shared a last common ancestor ~8.0 mya, far earlier than the data suggested by other molecular analyses. *Ateles belzebuth* diverged from other spider monkeys ~5.7 mya and *A. hybridus* around ~4.6 mya; the divergence between the trans-Andean forms (*A. hybridus*, *A. fusciceps*, and *A. geoffroyi*) and *A. paniscus* dates to ~4.0 mya. These early cladogenic events preclude a significant role for Pleistocene Refugia Theory to explain patterns of speciation within *Ateles*. Our results challenge previous ideas about spider monkey evolutionary history and suggest a new biogeographic scenario for the distribution of *Ateles* in South and Central America.

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Influential variables on osseous tooth socket healing time.

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Tooth loss is an indicator of various pathological and physiological processes or caused intentionally (ablation) or unintentionally (accidental trauma). The soft tissue healing process has been studied but the time required for bone to fill a socket and its macroscopic appearance throughout this process is unclear. A schedule to estimate time since tooth loss from osseous socket fullness was previously derived by the author from a radiographic series of modern dental patients. This paper reports on the application of those data to three dry bone assemblages (764 sockets) from medieval Germany and England to discern additional criteria.

Time since tooth loss was estimated using data from the radiographic study and took into consideration whether the socket was ossifying or ossified (by fullness), sex, socket location, and presence of neighboring teeth. New criteria tested were dental health status, presence of interdental ridges, and internal socket appearance to determine whether these factors significantly affected duration of socket healing.

The results indicated that total socket ossification is either accelerated or delayed by up to three weeks by mesial and distal ridge

presence and descriptive appearance of the buccal, lingual, and apical sections of the internal socket. Further study is required to determine whether these are correlative or causative relationships. These data, in conjunction with those derived from the radiographic study, may be reliably applied to healing or healed sockets in osseous remains to estimate how long before death a permanent human tooth was lost or removed.

Great ape virtopsy as a tool for musculoskeletal structure-function analysis.

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Musculoskeletal and functional biomechanical data from extant great apes and humans form an important comparative basis for the inference of structure-function relationships from fossil hominin remains. However, still relatively little is known about the detailed quantitative relationships between skeletal and soft tissue structures in extant hominoids. We show that virtopsy (virtual autopsy) is a convenient means to fill this information gap. Using biomedical imaging data of great apes permits non-invasive analysis of hard and soft tissue structures, and the characterization of muscular topography and bone morphology in one and the same specimen. Here we analyze the topographic relationship between femoropelvic muscular attachment sites and surface morphology of the proximal femoral shaft in great apes and humans. Virtopsy data indicate that, in all hominoids, the origin of the *vastus lateralis* muscle is anterior to the insertion of *gluteus maximus*, and anterior to a bony crest on the femoral diaphysis known as the lateral spiral pilaster (LSP). In gorillas and orangutans, the insertion of *gluteus maximus* is on the anterolateral side of the LSP, while in chimpanzees, it is on its posteromedial side, like in modern humans. Our results thus indicate that the surface morphology of the proximal femoral shaft reflects phyletic relationships rather than locomotor similarity between taxa. We discuss the implications of these findings for the functional interpretation of fossil hominin postcranial remains.

Social correlates of androgen levels in the siamang (*Symphalangus syndactylus*).

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The Challenge Hypothesis (Wingfield et al. 1990) posits a correlation between male androgen levels and mating system, male-male aggression in a sexual context, and parental effort. This model has received support across a variety of taxa, including primates. Most primate studies refer to multi-male societies with high levels of male-male aggression and limited paternal care. To expand this dataset, I tested predictions of the Challenge Hypothesis in a population of wild siamangs (*Symphalangus*

syndactylus), small apes characterized by intense territoriality, monogamous/polyandrous grouping, dominance relationships between co-resident males, and varying amounts of paternal behavior. I collected behavioral data on 11 siamang groups (five one-male, six two-male groups) between August 2007 and April 2009. Over a 13-month period, I collected 747 fecal samples from 21 adult males, and subsequently radio-immunoassayed testosterone levels. Results show no effect of grouping, rank, frequency of intragroup aggression and intergroup encounters on male androgen levels. Testosterone levels were negatively correlated with paternal behavior. Highest testosterone values corresponded to a period of social instability (two attempts at supplanting a resident male). Males in two-male groups experienced higher rates of intragroup agonistic interactions and lower intergroup aggression than males in one-male groups. Results support the Challenge Hypothesis.

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Tarsiers and the stable isotope ecology of primate faunivory.

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Tarsiers are exemplary faunivores, consuming a wide array of invertebrate and vertebrate prey. The anatomy and behavior associated with this faunivorous diet has attracted much attention in part because it can inform competing hypotheses focused on primate origins. Yet the role of interspecific foraging competition is seldom addressed. Throughout their distribution, tarsiers appear to compete with scops owls (*Otus bakkamoena*) for resources. The functional similarities of the species include extremely large and forward-facing eyes, acute directional hearing for detecting prey, a flexible cervical spine, specialized feeding morphology for immobilizing prey, and efficient sit-and-wait ambush tactics. Accordingly, Niemitz (1985, 2010) proposed a high degree of food competition between tarsiers and scops owls. Here we report on the isotopic ecology of these sympatric faunivores to test the hypothesis that dietary overlap under nocturnal conditions has favored convergent visual adaptations. We measured the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of hair samples from tarsiers and feather fragments from scops owls with overlapping distributions in Borneo and the Philippines. Carbon isotopes vary as function of canopy cover, and thus understory habitat use, whereas nitrogen isotopes vary as a function of trophic level and can distinguish subtle differences in the proportion of insect and vertebrate prey. The findings from this study are expected to inform hypotheses not only on how the visual systems of vertebrate predators evolve under dim light conditions, but also on how dietary overlap and competition for insect resources might have shaped the functional anatomy and evolution of early primates.

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Cross-sectional geometry of the mandible in neonatal common marmosets (*Callithrix jacchus*).

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Marmosets are unique among callitrichids in habitually gouging trees with their anterior teeth to stimulate exudate flow. Previous data suggest that adult marmosets do not generate relatively large bite forces during gouging and their mandibles display decreased load-resistance ability relative to closely-related non-gouging tamarins. We test the hypothesis that the differences in cross-sectional morphologies between adult marmosets and tamarins are present in the jaws of neonatal marmosets compared to tamarins.

Jaws from six stillborn common marmosets (*Callithrix jacchus*) and cotton-top tamarins (*Saguinus oedipus*), respectively, were microCT scanned at 20.5 μm resolution. We quantified the cross-sectional properties and mechanical indices of cortical bone using slices perpendicular to the occlusal plane at the symphysis and midpoint of each deciduous tooth.

Results suggest little difference in absolute cross-sectional area between marmoset and tamarin neonates. Adjusting for jaw length as a biomechanical standard, marmoset neonates appear relatively robust, particularly in the premolar region. Parasagittal bending resistance follows adult trends with neonatal marmosets displaying decreased load-resistance ability compared to tamarins, except in anterior premolar region. Relative bending-resistance ability ($\text{Ixx}/\text{jaw length}$) is greater in neonatal marmosets compared to tamarins, contrasting with the adult pattern. The relative robusticity of neonatal marmosets is likely due to their absolutely shorter jaws at birth. Ontogenetic data indicate that the initially short marmoset jaw undergoes accelerated postnatal growth and is relatively elongated at weaning. These data suggest the postnatal changes in the marmoset mandible, resulting in reduced load-resisting ability compared to tamarins, may result from plasticity related to dietary processing.

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Understanding footprints: intra-trail variability and its causes.

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Here we examine the influence of substrate on footprint formation, and explore the role of substrate as a cause of intra-trail variability with new software developed for the

analysis of plantar pressure data (pSPM). Using a Holocene footprint site from Namibia, this new approach to human ichnology attempts to move the discipline away from subjective interpretations of single prints to objective interpretations based on mean and median prints from complete trails. This allows the intra-trail variability to be documented quantitatively, and linked to changes in substrate. We suggest that doing so will allow more sophisticated interpretations of biomechanical inference than hitherto possible, and we argue for consideration of the importance of factors that lead to variability in footprint morphology within and between trails, especially when interpreting sites of significance to paleoanthropology such as those at Laetoli (~3.6Ma) or Ileret (~1.5Ma). Laetoli was formed via ash fall in open terrain while Ileret was associated with fluvial overbank deposits close to standing water. Comparing these two sites is critical to understanding the transition in foot anatomy and gait across the transition from *Australopithecus* spp. to *Homo* spp.. Data presented here provide a model case to help us identify the likely role of substrate at these two ancient sites, and the factors which need to be considered in making quantitative comparisons. A series of preliminary comparisons of the Ileret and Laetoli footprint sites are presented using pSPM with the benefit of knowledge of intra-trail variability obtained from the Holocene footprint site in Namibia.

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Primates are all brain and little brawn: a preliminary investigation into tissue tradeoffs.

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Despite major differences in morphology and ecology, mammalian species have broadly similar metabolic requirements relative to body size. This commonality suggests that the total energy available for meeting the metabolic needs of the various somatic organs and tissues is constrained. Thus, available energy is allocated differentially depending upon the metabolic needs of each species. This is the basis of the Expensive Tissue Hypothesis, which proposes an explanation for how humans are able to maintain large, energy-expensive brains while having resting metabolic rates that are not substantially different from other mammals. Muscle tissue, despite relatively low costs when at rest, requires a substantial portion of overall daily metabolic requirements. Thus, we hypothesize that muscle mass will be lower in primates with relatively large brains. To test this hypothesis, we obtained total muscle mass values via dissection for 12 primate species and combined this information with literature-based data from an additional 11 species. We also compiled muscle mass values from literature sources for 56 non-primate mammals. In addition, endocranial volumes (ECVs) were obtained from the literature for each primate species. We compared primates and

non-primate mammals in relative muscularity, and examined how muscle mass covaries with ECV. Results indicate that primates are hypomuscular when compared to non-primate mammals ($P < 0.001$). We also documented a negative correlation between relative muscle mass and relative ECV ($P < 0.05$). This suggests that primates may 'save' energy by reducing muscle mass, which can then be allocated to the brain and other tissues.

Fecal glucocorticoid responses in wild orangutans following human visitation.

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Nature-based tourism can generate important revenue to support conservation of biodiversity. However, rapid and unmonitored development can cause deleterious effects on animal well-being. Altered levels of glucocorticoids have been documented in several species/populations of wildlife exposed to tourism. To monitor any stress effects of tourism on wild orangutans, we developed an enzyme immunoassay capable of measuring fecal glucocorticoid metabolite (fGM) levels in *Pongo pygmaeus*. Using samples from captive animals, we determined that, if samples cannot be extracted immediately following defecation (which is unlikely under most field conditions), then they should be extracted within 3 hours following defecation. Following this protocol, fecal samples ($N = 53$) from 2 wild habituated orangutans in the Lower Kinabatangan Wildlife Sanctuary of Sabah, Malaysian Borneo, were collected and processed before, during and after tourist visitation events. We predicted that fGM concentrations would be elevated on the day after tourist visitation compared to samples taken before tourist visitation.

fGM levels were significantly elevated in samples collected the day after tourist visitation (indicative of elevated cortisol production on the previous day during tourist visitation). We conclude that animals used for this ecotourism project are not chronically stressed, and that animal temperament, the presence of coping/escape mechanisms, social confounders, and variation in amount of tourism may explain differences among previous experiments. While permanently altered stress responses can be detrimental, preliminary results in these wild habituated orangutans suggest that low levels of predictable disturbance can likely result in low physiological impact on these animals.

This study was funded by the Great Ape Conservation Fund of the United States Fish and Wildlife Service, the Disney Wildlife Conservation Fund, and Indiana University.

Primates as predictors of mammal community richness in the forest ecosystems of Madagascar.

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Priority areas for conservation are usually identified by species distributions. Since most biodiversity remains poorly studied, a subset of charismatic species, such as primates, are often used as surrogates for total biodiversity. A central question is therefore, how effectively do primates predict the pooled species richness of other mammalian taxa? We used lemurs as indicator species to predict total non-primate mammal community richness in the forest ecosystems of Madagascar.

We collected species lists of endemic terrestrial mammals for 34 mammalian communities from 30 forested areas. To account for spatial autocorrelation and as a proxy for environmental variables, we used WWF's ecoregional classification of Madagascar's natural habitats. Two sets of predictor variables were entered hierarchically into a regression analysis: ecoregion, and lemur species richness. Our results indicated that 86% of the variation in total non-primate mammal community richness was explained by ecoregion and lemur species richness together. The majority of this variation was accounted for by ecoregion alone, while the unique contribution of lemur species richness net of ecoregion was 5.2% ($F = 9.705$, $df = 28, 27$, $p < 0.01$). When individual fauna components were examined, the predictive relationship for carnivoran and rodent species richness was significant. Lemur species richness did not significantly contribute to the regression model for afrosericid richness.

We conclude that habitat type is a pragmatic basis for the assessment of mammal conservation priorities in Madagascar. Lemurs effectively predict total non-primate community richness. However, complete representation of biodiversity cannot be achieved through surrogate species alone.

Basketmaker mortuary patterns at Falls Creek.

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In the 1930s, Zeke Flora and Earl Morris excavated the Falls Creek Rock Shelters, a Basketmaker II site north of Durango, Colorado. The human remains and associated funerary objects were recently reunited from several different institutions for detailed re-analysis. The assemblage from this site offers a unique glimpse into Basketmaker mortuary practices, particularly due to the excellent preservation of material from the Burial Crevice, including mummification and preservation of perishable objects. In this study, we present interpretations regarding mortuary practices related to age and sex. Patterns were observed by age and sex

regarding the distribution of burials at the site as well as the types of associated funerary objects. The site includes three burial locations, including the burial crevice and two separate areas outside the crevice. Infant burials were distributed throughout these three locations, whereas subadults and females were found in the burial crevice and one of two areas outside the crevice. Males were primarily found in a second area outside the crevice and are generally underrepresented. Infants and subadults were often wrapped in hides. Several subadults exhibited the most elaborate burial goods. Aprons and necklaces were associated with females, whereas pendants and projectile points were associated with males. The results of this study will also be discussed within a regional context.

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Activity or age? Determining the etiology of enthesopathies in the Newburgh Colored Burial Ground.

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Many anthropological studies focus on musculoskeletal stress markers (MSM) in an effort to understand their presence as the result of particular physical activities. Enthesopathies, a type of MSM, are bony formations or lytic lesions present at attachment sites of tendons and ligaments. Recently, several studies have not only questioned the methodology employed in MSM research, but also the general acceptance of enthesopathies as indicators of activity-induced stress.

The current study assesses the frequency of enthesopathies in the skeletal remains from the Newburgh Colored Burial Ground (1830s-1870s). The skeletal sample represents a population of 99 African Americans many of who likely experienced enslavement during their lifetimes. The daily activities of the population would have varied, including physically demanding jobs associated with agriculture, industry and working the docks located on the Hudson River. Analyses of the sample are essential to understanding the daily lives and stressors of blacks in upstate New York during the transition from enslavement to freedom.

Several insertion sites in both the upper and lower limbs were coded for the presence of enthesopathies. Data are analyzed with special consideration of both extrinsic and intrinsic factors known to influence enthesopathy development, i.e., fibrous v. fibrocartilaginous, age, sex, non-weight bearing v. weight bearing limbs. Among the results presented and discussed is the positive correlation between skeletal age and enthesopathy presence. Discussion also includes comparisons with previously conducted studies on the impoverished and disenfranchised, including the New York African Burial Ground.

Testosterone, development and aging in wild chimpanzees.

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Considerable evidence suggests that the steroid hormone testosterone mediates major life-history trade-offs in primates, supporting mating effort at the expense of parenting effort and survival. Specifically, the "challenge hypothesis" posits that testosterone is elevated during life-history phases when males are competing for mating opportunities. Most wild data, however, come from short-term, cross-sectional studies that cannot track individuals across the lifespan. We used >6000 urine samples collected over 13 years from male chimpanzees living in Kibale National Park, Uganda to examine longitudinal changes in testosterone production in this species. We also employed a novel measure of urinary creatinine to track developmental changes in muscle mass. We predicted that shifts in testosterone production would correlate with male mating effort over the life course, including physiological investment in sexually dimorphic muscle, and behavioral investment in dominance striving. Our results were consistent with this prediction. Males showed steep and steady increases in testosterone from the age of 9 to 15, a period in which they began to challenge other adults for status, and rise in dominance rank. Male testosterone levels and rank peaked in the late teens/early twenties, after which both showed steady declines with age at the population level. Consistent with the challenge hypothesis, however, males who maintained high rank at older ages continued to produce high levels of testosterone. Indirect measures of muscle mass showed similar patterns.

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Epigenetic alterations and stress among new mothers and infants in the Democratic Republic of Congo: a biocultural look at the intergenerational effects of war.

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Adaptation is a complex process involving genetic, physiological, and behavioral mechanisms. There is growing evidence that epigenetic modifications may serve as an intermediate adaptive mechanism that mediates between the rapidly changing environment and our slowly evolving genome and, thus, may provide a possible mechanism for phenotypic plasticity during fetal development. We test the idea that epigenetic modifications may create heritable changes in response to extreme

environmental stressors that affect infant health in a multigenerational manner.

Maternal blood and umbilical cord blood samples were collected from 25 mother-infant dyads in the eastern Democratic Republic of Congo. Detailed ethnographic interviews and peri-natal trauma surveys were administered to all mothers. Medical histories of mothers were accessed and birth weights and gestational age of infants were recorded. DNA was extracted and treated with sodium bisulfite. A 321 bp promoter of *NR3C1* with 39 CpG sites was amplified, cloned and sequenced. An average of 21.5 clones per sample was sequenced. *NR3C1* is a glucocorticoid receptor that was previously implicated in methylation-mediated changes in gene expression associated with differences in childhood trauma. When treating maternal stress exposures as categorical variables, our preliminary results show increased methylation in stressed mothers (material deprivation, emotional stress, recent rape, war stressors). In contrast, infants of less stressed mothers (material deprivation, emotional stressors, war stress) show increased methylation with respect to their mothers and with respect to infants of stressed mothers. Our results suggest that methylation patterns differ between mothers and infants and may correlate with specific maternal stress exposures.

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Frequencies of periostitis and enamel hypoplasias in a Colonial Maya population.

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The frequencies of enamel hypoplasias and periostitis exhibited by the early Colonial Maya burials recovered from Tipu, Belize were examined. The population studied is housed at SUNY Plattsburgh in New York and is a subset of the Tipu Collection. To our knowledge, the correlation between enamel hypoplasias and periostitis and their relationships to the overall health of individuals from this population is yet to be studied. This sample of 95 skeletons consists of individuals complete with established demographic data. Of this sample, 69 of the individuals are male and 26 are female. We evaluated the frequencies of enamel hypoplasias and periostitis in males and females and found that both sexes have comparable rates of periostitis as well as comparable rates of enamel hypoplasias, although females had a slightly higher percentage. However, a greater percentage of females than males displayed both periostitis and enamel hypoplasias together. Overall, we found that enamel hypoplasias occurred in conjunction with periostitis more often than without. Of the 95 skeletons studied, a higher percentage displayed both enamel hypoplasias and periostitis, while fewer displayed enamel hypoplasias alone. However, periostitis, occurred more often without the presence of enamel hypoplasias at. The implications of these findings will be discussed in this paper as they relate to the overall health of the sample.

Comparative interpretation of perimortem trauma from Spanish Conquest of Inca Empire, Peru.

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While the bioarchaeological interpretation of violence perpetrated by the Spanish during the conquest of the Inca Empire is often guided by written historical documents, critical close reading and nuanced analysis are necessary in order to identify and understand the perpetrators and victims of violence during this chaotic time. For example, the presence of injuries from European weapons, such as firearms or steel edged blades, indicates that the victims were dispatched or injured after conquest; however, the perpetrators of said violence could be Spaniards, indigenous Andean allies of the Spanish armed with European weapons, or even allies recruited from different parts of the Americas. Furthermore, the effect of 16th Century European weapons on human skeletal remains is little known, so the interpretation of the correspondence between the weapon and the injury is particularly challenging. In this poster, we examine characteristics of perimortem skeletal injuries, weapon, class, and interpersonal aspects of weapon utilization from historical and forensic case studies to aid in the interpretation of the high frequencies of perimortem traumatic injuries (25.0%) and injuries consistent with European weapons from a sample of indigenous human skeletal remains from Puruchuco-Huaquerones, Peru. Our analysis attempts 1) to reconstruct the roles of some indigenous Andean peoples in these violent times, 2) to illuminate the context of the violence of Spanish Conquest, and 3) to aid in the interpretation of traumatized bone from different types of weapons.

Hand and foot proportions of the mountain gorilla, *Gorilla beringei beringei*.

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Hand and foot proportions vary with locomotion, posture, and manipulative behaviors across primates. However, reliable information is often lacking about ray identity of disarticulated phalanges in museum collections, hampering efforts to investigate cheiridial proportions in many primates. Here, we report new data on hand and foot proportions of mountain gorillas (*Gorilla beringei beringei*) based on skeletons recovered by the Mountain Gorilla Skeletal

Project in Rwanda using controlled procedures. We calculated maximum length proportions for metatarsals, metacarpals, and phalanges of 3 adult males and 7 females.

Our results generally agree with hand proportions reported for gorillas by Susman (1979, *AJPA* 50, 215), with some notable exceptions. While six individuals showed a II>III>IV>V metacarpal length sequence, four individuals displayed a III>II>IV>V sequence. All individuals exhibited a III>IV>II>V manual proximal phalanx sequence; all but one showed a III>IV>II>V intermediate phalanx sequence; and the distal phalangeal sequence varied.

Within the foot, seven individuals displayed a II>V>III>IV metatarsal length sequence, two showed a V>II>III>IV sequence, and one showed a II>V>III>IV sequence. While seven individuals displayed a IV>III>II>V proximal phalanx sequence, three displayed a III>IV>II>V sequence. The sequence of intermediate phalanx length was IV>III>V>II in eight individuals, and IV>III>II>V and III>IV>V>II in the remaining two. Pedal distal phalangeal sequence was variable.

Our results show some important differences in hand proportions between *G. b. beringei* and other gorillas, and provide much-needed data on pedal proportions, that may be linked to hand and foot function involved in the high levels of terrestriality practiced by mountain gorillas.

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Arboviruses in historic Natchez: genetic and socio-cultural factors in mortality disparities.

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This project will assess epidemiological patterns of arboviruses in historic Natchez, Mississippi during the nineteenth and first decade of the twentieth century in regard to racial disparities in mortality rates. Using the sexton records of the Natchez City Cemetery, information on 19,000 deaths between 1822 and 1909 was analyzed by race and age in order to examine Arboviruses mortalities related to yellow fever, malaria, and dengue fever. In the existing literature on the American South in the 19th century, there is a preconceived notion that throughout the South thousands of Black slaves and freedmen, mostly adults, were dying due to disease transmitted by mosquitoes or arboviruses. In Natchez, however, this was not the case, and two predictable trends proved contrary to this notion based on race and age. First, arboviruses accounted for 9.1% of the total mortalities over the 87 year period in the White population while only 1.3% in the Black population. Secondly, Black children were more susceptible to arboviruses than White children. In 1890 of the total mortalities related to Malaria, 27% were Black children while White children accounted for 2.7%. While these are just a few statistics, they repeat throughout the nineteenth

and early twentieth century. From these conclusions, additional factors, both socio-cultural and genetic will be discussed in how such disparities both propagated the slave trade and struck fear of slave revolts.

Methodological advances in TCA age-estimation technique.

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The increase use of the Teeth Cementum Annulations (TCA) technique for individual age estimation in archaeology has recently been challenged on issues pertaining to the identification of the actual cementum lines, and the reduction of intra/inters observer errors. In order to resolve these matters, explicit "expert" choices for rejection or inclusion of dubious annulations need to be rigorously described by the original author of the method.

Our study is thus centered on the description and the visual discrimination of cementum pictures. Main biological (pathologies) and technical (counting protocol) factors responsible for tooth cementum variance are described and a set of 8 teaching slides is presented to clarify previously ambiguous features. Additionally, new reference tests confirm the high correlation ($r \approx 0.85-0.9$) with true chronological age.

We systematically tested correlations between cementum rings and true age along the root's longitudinal axis to identify and describe the best possible cutting location, the middle third part, which has never been formally tested. Pathological (infections) and physiological (resorption) aspects affecting cementum deposition are also explored to explain counting variance between various loci.

Considering that TCA is the only direct, reliable, method for age estimation for adults which is not subjected to statistical vagaries, and since its correlation with true chronological age is very high, all issues affecting the method should be fully addressed before any premature dismissal.

Influences on occipital condyle position in Anthropoidea.

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Researchers have studied the morphology of the foramen magnum and occipital condyles in an effort to relate these structures to posture and locomotion in fossil taxa. Previous work has shown that many basicranial features are influenced by cranial-base flexion and relative brain size, yet the effect of positional behavior on atlanto-occipital (AO) morphology has not been clarified. Demes's (1985) model of the AO joint suggests that joint-force vectors differ

between orthograde and pronograde primates, such that, in more orthograde species, the reaction forces transmitted across the AO joint are directed posterosuperiorly, whereas in pronograde taxa, reaction forces are directed anterosuperiorly.

The goal of this study was to investigate the influence of neck posture on the relative position of the occipital condyles. Aspects of Demes's model and other biomechanical principles were utilized to develop predications for condylar position. Specifically, we tested whether anthropoids characterized by more pronograde neck postures possess more anteriorly placed occipital condyles along the margin of the foramen magnum than those with more orthograde neck postures. Basicranial features of 11 extant anthropoid species were quantified using three-dimensional coordinate data, and data on neck posture were taken from the literature. Relationships between neck posture and condylar position were analyzed using phylogenetic comparative methods. Results do not support a relationship between neck posture and condyle position, indicating that condylar position cannot be used to infer posture in fossil taxa.

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Evolution of human encephalization: evidence from a comparative analysis of brain size and fat storage.

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The human brain stands out among other mammals by being unusually large and energetically expensive. One of the most prominent hypotheses explaining its evolution is the Expensive Tissue Hypothesis (ETH), which proposed a trade-off between brain size and the size of the digestive tract. However, using a newly compiled sample of organ masses and associated brain size from 100 mammalian species, including 23 primate species, we show that the ETH, and any other potential trade-off between brain size and expensive visceral organs, is refuted in both primates and in mammals in general. Nonetheless, we find evidence of energy constraints on brain size evolution, as brain size and the amount of adipose depots are negatively correlated in mammals ($N=100$, $\beta=-0.07$, $P=0.017$), suggesting that encephalization and fat storage are compensatory strategies to buffer against starvation. We assume that these two strategies can be combined if fat storage does not overly hamper locomotor efficiency. We propose that human encephalization was made possible by a combination of stabilization of energy inputs and redirection of energy from locomotion, growth and reproduction.

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Variation in 2D:4D between captive and free-ranging primates: implications for digit ratio research.

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There is extensive indirect evidence from human studies showing that the second-to-fourth digit ratio (2D:4D) in adults reflects the action of prenatal androgen effects (PAE) on physical and behavioural development. Primate individuals and species that exhibit high levels of competitive and status-related behaviours have been found to have lower 2D:4D, implying higher PAE. These kinds of investigations, however, can potentially be confounded by the effects of rearing environment. Here we address this issue by comparing datasets between captive and wild groups belonging to three species.

Our comparative sample included *Macaca mulatta* (305 zoo and 87 free-ranging), *Pan paniscus* (25 zoo and 43 wild-born, sanctuary-living), and *Pan troglodytes* (252 zoo and 88 wild-born, sanctuary-living). Results indicated a significant interaction between captivity and side: zoo residents had lower 2D:4D ($F=11.6$, $p<0.001$), which was most marked on the left side. There was also a significant interaction between species and sex ($F=3.7$, $p=0.025$), such that chimpanzees had a significantly greater sex difference than rhesus macaques (difference=0.02, $t=2.7$, $p=0.007$), while bonobos were intermediate.

In conclusion, left hand 2D:4D may be reduced by environments characterizing zoo-living compared with free-ranging, possibly due to differences in maternal stressors. These effects are more marked in the left hand. This contrasts with the human pattern where 2D:4D is lower in the right hand. Furthermore, the more marked sex-difference in 2D:4D in male-dominant chimpanzees, compared to bonobos and macaques, might suggest that PAE plays a role in prenatally programming female dominance in these species.

Today is the tomorrow we worried about yesterday: changes in stress axis function across women's reproductive transitions.

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The negative effects of stress on health are well recognized, yet most research on

women's stress does not adequately account for the longitudinal changes in stress physiology as women transition between reproductive phases. We initiated an investigation of said changes in a population of healthy women from rural Guatemala. We examined one of those understudied transitions: from post-partum amenorrhea (PA) to the resumption of regular ovarian cyclicity (ROC). We evaluated stress (free cortisol), reproductive (estrone glucuronide, pregnandiol glucuronide, follicle stimulating hormone beta-subunit and human chorionic gonadotropin beta-subunit) and metabolic energy (adiponectin and c-peptide) hormone levels in urine specimens collected from 22 women as they recovered their fertility after giving birth. Using linear mixed models we were able to distinguish clear variation in hormone profiles across the PA-ROC transition ($p<0.05$). Once ROC resumed, day of the menstrual cycle did not predict cortisol levels if analyses were restricted to ± 14 days around the day of ovulation. However, when analyses were extended beyond this 28-day-period, then day of the menstrual cycle became a significant predictor of cortisol levels. We will use this information to develop a model of the relationship between stress and reproductive biology during this and other transitions. Our goal is to provide a first account of longitudinal changes in the stress axis, its response to energetic, health and psychosocial challenges and its effects on reproductive axis functioning.

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Endocranial shape in early modern humans.

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Humans have more globular brains and therefore endocrania than our extant and extinct relatives: chimpanzees and Neanderthals both have anteroposteriorly elongated endocrania. Based on an ontogenetic series of recent modern humans, we have previously shown that this modern human globular shape develops directly after birth during an ontogenetic phase that is absent in chimpanzees and Neanderthals. However, it is unclear at which point in the evolution of our species this unique pattern of brain development appeared.

Here, we aim to trace its evolutionary origin. Based on the shape of fossil adult humans, we investigate the morphological evolution of *Homo sapiens* endocrania using geometric morphometrics. Investigating representatives of *H. sapiens* from different time periods (comprising samples from Jebel Irhoud, Qafzeh, Skhul, Mladec, Cro-Magnon) makes it possible to assess when and how (gradually or rapidly) this developmental phase appeared in the course of recent human evolution. As several relevant fossils are fragmentary and partly deformed, they require reconstruction before they can be analyzed. To this end, we generate and reconstruct virtual endocrania based on CT scans. We first use mirror-imaging and

segmentation techniques, and then the thin-plate-spline interpolation function for reference-based reconstruction. Generating multiple reconstructions based on landmarks of 60 recent human endocasts, we keep track of the reconstruction uncertainty throughout the shape analysis. We document temporal trends of endocranial shape within anatomically modern humans during the Late Pleistocene and discuss potential implications for the evolution of the modern human brain.

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Functional morphology of the trunk in chimpanzees.

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In accordance with the comparatively short lumbar region, long iliac blades, and small lateral epaxial tracts, locomotor studies have suggested that chimpanzees possess only limited trunk mobility. For instance, chimpanzees seem to lack the intensive sagittal bending occurring in monkeys during asymmetrical gaits. However, non-locomotor activities may reveal a greater range of motion because the maximal mobility of a joint is rarely used during locomotor activities. To test whether a greater range of trunk mobility is used during non-locomotor activities than during locomotion, we collected a comprehensive data set on trunk motions in chimpanzees in a zoo and a semi-natural environment. This information is integrated with morphological details such as the muscle fibre type composition of the perivertebral musculature, which we studied in 2,1 adults using immune-histochemistry. Our results confirm that chimpanzees show a far greater range of trunk motion during non-locomotor activities than during locomotion. For example, maximum lateral bending was observed during hanging positions. In contrast to the hypaxial muscles, which contained on average 66% fast fibres, only about half the fibres were fast in the epaxial muscles. The homogeneous fibre distribution indicates that all epaxial muscles are equally well suited to mobilize and stabilize the trunk. The relatively small lateral epaxial tracts combined with only 50% fast fibres may be associated with the reduced sagittal extension in galloping chimpanzees, while size and the fibre composition of the hypaxial muscles may facilitate spine flexions comparable to other galloping primates.

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Birth seasonality in relation to rainfall and food in wild geladas (*Theropithecus gelada*) at Guassa, Ethiopia: variation within and between one-male units.

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Primates occupying seasonal habitats cope with predictable fluctuations in food supply by varying what they eat and how they obtain these food items, decisions which, in turn, impact female reproductive decisions and life histories. We investigated patterns of within- and between-group (i.e., population-wide) birth seasonality in relation to rainfall and primary food productivity in 15 social units of wild geladas (*Theropithecus gelada*) at Guassa, Ethiopia from January 2007-July 2011. Geladas occupy a higher altitude and colder climate than any other African primate, and are expected to be especially responsive to seasonal fluctuations in climate and food availability. We provide evidence (A) of within- and between-group birth seasonality among geladas at Guassa, and (B) that the birth peak at this site is timed to coincide with seasonal increases in rainfall and food abundance. Using circular statistics, we found that this population of geladas reproduces seasonally, with a protracted peak (69% of 99 births occurred from July-December, mean month = October) encompassing the wettest months of the year which were also characterized by high food abundance. In 12 of the 13 social units with multiple births, most births occurred during the population-wide birth peak. The birth peak appears timed to ensure high food availability during late gestation and early/mid lactation. Our results suggest that geladas at Guassa are pursuing an income II breeding strategy, wherein the most energetically expensive phase of reproduction for females (i.e., lactation) is timed to coincide with annual peaks in nutrient or energy availability to maximize maternal survival.

This study was funded by Pittsburgh Zoo, Margot Marsh Biodiversity Foundation, Primate Conservation Inc., and Cleveland Metroparks Zoo.

A model-based approach to compute 3D bipedal locomotion based on anthropological data – application to non-human primates and early hominids.

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Identification of locomotion laws requires understanding the anatomical structures and the mechanisms involved during this specific movement. To this end, experimental studies in biomechanics have highlighted numerous principles such as minimizing energy, Jerk or joint torques. In palaeoanthropology, experiments are obviously not possible when studying fossil specimens. In this study, we propose a model-based approach of the pelvic

girdle and hindlimb to compute 3D bipedal locomotion while taking into account anatomical data. This method was designed to test palaeoanthropological hypotheses due to some uncertainties in the reconstruction of skeletons (e.g., long bones dimensions, femoral bicondylar angle) and evaluate their impact on the predicted locomotion. Contrary to musculoskeletal models which require many accurate knowledge (which is missing for the fossil), our approach combines an inverse kinematics method and an optimization loop which aims at modifying a reference ankle trajectory until a set of criteria is minimized. The goal is to adapt angular trajectories in order to satisfy a set of constraints (e.g., footprints) while minimizing energy criteria. This method is tested on 10 modern humans. Results obtained with this method are close to experimental data and mean error on internal work is less than 6%. We also apply our method to a skeleton of *Pan paniscus* (Bonobo), and show that the resulting motion is close to those commonly described in comparative biomechanics. Finally, we test our method to a specimen of *Australopithecus afarensis* (A.L. 288-1) and show that step length influences internal work and may lead to an optimal value.

The relationship between height and dental caries – a life course perspective.

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For years, researchers have been on the lookout for ways and means to study the interaction between nature and nurture. An individual's biological resources are influenced by their genetic endowment, their pre-natal and post-natal development and their social and physical environment in early life. Adversity in childhood becomes 'embodied' at an early age, its full impact manifesting later in life. For example, socioeconomic circumstances influence foetal development and growth during childhood. Poor foetal development and delayed linear growth are associated with increased mortality. A variable commonly used in social sciences and social epidemiology to capture biological fitness is height. In this presentation, we will review how height has been used in social epidemiology and illustrate that use with an example. We interviewed and examined 652 13-years old Brazilian adolescents to investigate whether or not height was associated with dental caries experience in Brazilian adolescents. Our hypothesis was that taller children had better biological resources and would have better oral health signified by lower levels of dental caries measured by decayed, missing and filled teeth (DMFT) index. Information on anthropometric measures, indicator of socioeconomic position, family environment, and health behaviour was also collected. After dichotomizing the outcome measure into high and low caries levels, logistic models were used in a series of simple and multiple regressions. Adjusted results showed that taller adolescents were less likely to experience high levels of caries. In conclusion, there is a relationship between height and dental caries experience in this sample of Brazilian adolescents.

Sub-Saharan African and West Eurasian maternal (mtDNA) lineages in the Dominican Republic.

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This research uses mtDNA to estimate the contributions of sub-continental West Eurasian and sub-Saharan African regions to the modern admixed population of the Dominican Republic; which also has Native American ancestry. We expect results to resemble those reported in Puerto Rico, where African and Eurasian mtDNA lineages resembled those of populations in West-Central Africa, and the Atlantic Iberian Islands.

HVR-I sequences of 570 samples collected in 43 locations across the country indicate that 71% of Dominican mtDNAs originate in sub-Saharan Africa (n=403), while 15% originate in West Eurasia (n=83). After dividing the country into three large geographic regions based on historical and climatological criteria, we found that the Cibao and Southeastern regions show similar African (63% and 69%, respectively), and Eurasian (18.2% and 13.5%, respectively) ancestries; while the Southwestern region shows a much higher African (89%) and a lower Eurasian (7%) ancestry. An AMOVA test on African mtDNAs showed that the vast majority of the variation is found within regions (98.77%, $p < .001$).

Large contributions of West and West-Central African lineages to the Dominican population (59% and 18%) have been found. Principal Component Analysis confirmed these findings by clustering the Dominican samples close to modern Western and Central African populations. Bayesian probability of origin estimates showed that Dominican mtDNA sequences of sub-Saharan African ancestry have a 48% and 23% chance of originating in West and Central Africa, respectively. Sequencing of HVR-2 is currently underway for all samples of Eurasian origin in order to aid in further haplogroup identification and analysis.

This study was funded by the National Science Foundation Graduate Research Fellowship grant No. DGE-0802261 to M.A.N.C., and grant SBR-0624064 to J.C.M.C.

Are loading patterns reflected in the relationship between musculoskeletal stress markers and biomechanical properties of the humeral diaphysis?

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Physical activity should affect both musculoskeletal stress markers (MSM) at entheses and bone diaphyseal strength. Furthermore, the same mechanisms of bone remodeling may be responsible for both the appearance of MSMs and altering of diaphyseal

dimensions. Thus, these two types of measurements should covary within individuals. The relationship between MSM and bone biomechanical properties, namely torsional and average bending rigidity (J) of the diaphysis, was studied using three skeletal samples: early 20th century Finnish (Helsinki) and two medieval English (Blackgate and York) populations. Covariance between MSMs and J was studied by scoring three fibrous MSMs (pectoralis major, teres major and deltoid) and measuring J of four cross-sectional locations (80%, 65%, 50% and 35% of humeral length from the distal end). As some of these cross-sectional locations house the attachment for the studied muscles and some do not, location-specific as well as overall covariance between MSMs and J could be studied. Results indicate that although there is some covariance between MSMs and J there is also a considerable amount of variance in MSM that could not be explained by physical activity, age, size, or sample. Covariance between MSMs and J was not location-specific. Furthermore, significant results were found for males only. In this study the causal factors behind the development of MSM were studied secondarily as the covariance between activity-related changes in MSM and J. It seems that although MSMs reflect in part physical activity there are also other factors that have a significant influence on their appearance.

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Ontogeny of sexual size dimorphism and environmental quality in Guatemalan children.

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Human growth data from Guatemala were analyzed to test the hypothesis that the degree of sexual size dimorphism (SSD) may be an indicator of environmental quality. The sample consists of Guatemalan school children (6 to 16.99 years of age) distributed into high, middle and low socioeconomic status (SES) groups. SSD was calculated as a ratio of male to female height, with higher values implying a greater degree of dimorphism; while SES was used as a proxy for environmental quality. Results suggest that between 6 and 11.99 years of age, SSD remains constant for all SES groups. Starting from 12 years of age, SSD increases for both high and middle SES groups. However, in children that belong to the low SES group, SSD stays low until 13 years of age, after which SSD shows lower increase than in higher SES groups. Analysis of growth data for females and males suggests that low levels of SSD in the low SES group after 12 years of age can be related to developmental delays and a slower rate of growth in the lower SES males. This adds support to the "fragile male" hypothesis, which posits greater male sensitivity to a suboptimal environment during growth and development.

Temporal trends and regional differences in body size and shape of Europeans from the Late Pleistocene to recent times.

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This study is based on osteometric data of +2000 Holocene and Late Pleistocene *Homo sapiens* skeletons from Europe. Body size is represented by stature (estimated with a recently-revised anatomical method, when possible, or new long bone regression equations derived from this sample) and body mass (estimated from stature and bi-iliac breadth, if possible, or femoral head breadth). Body proportions are compared by regressing long bone lengths, clavicular lengths, and bi-iliac breadths against partial skeletal heights (PSKH = presacral vertebral heights + femoral length + tibial lengths).

Mean body size declined across the Last Glacial Maximum (the LGM), increased until the medieval period, declined again during the post-medieval period, and increased considerably over the last 100 years. The North/Central Europeans have been larger bodied than their Mediterranean contemporaries since ca. 5000 BP. The sum of femoral and tibial lengths reduced in relation to PSKH across the LGM, but since then this relative limb length has been stable. Clavicular length and bi-iliac breadth exhibit little or no fluctuation in relation to PSKH through all time periods. The clavicular length and bi-iliac breadth do not differ in relation to PSKH between North/Central and Mediterranean Europeans, but the Mediterranean Europeans from all Holocene time periods tend to have relatively longer lower limb bones and higher crural indices consistent with general ecogeographic predictions.

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Testing uniqueness of Inuit cranial shape and its effect on climate-shape analysis.

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Significant correlations between climate and cranial shape are thought to be driven by the inclusion of Inuit samples in the analyses (Harvati and Weaver 2006 *Anat. Rec.* 288A 1225-1233). This suggests a unique or extreme cranial morphology for the Inuit. We use geometric morphometric methods to (1) study the effect of including cold climate populations in analyses of climate versus cranial shape and (2) study the uniqueness of Inuit craniofacial shape. Our sample consists of 100 crania from 5 climatic regions. Regression of cranial shape on mean temperature and vapor pressure shows that excluding cold climate populations does not decrease, but in fact slightly increases the total percentage of cranial variation explained by climate in our sample. Using Principal Component Analyses we then describe the overall observed cranial variation. The Inuit sample does not show a unique morphology on any of the PCs. A clear climatic grouping appears on PC1 vs. PC2, with the Inuit sample grouping with other cold climate populations. Partial Least Squares analysis of total cranial shape versus climate also clearly shows that the Inuit cranial shape resembles that of other cold populations. A PLS analysis of craniofacial shape versus nasal cavity shape shows covariation between craniofacial and nasal cavity shape. The Inuit sample represents an intermediate combination of nasal cavity and facial traits. Our results suggest that the cranial morphology of the Inuit is neither extreme nor unique, and that this group follows the climate-related trend seen in other populations.

This study was funded by the University of Tübingen and Senckenberg Research Institution.

Effects of age-at-death, sex, body size and secular change on the biceps enthesis: a study of 3D surface areas.

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This study quantifies the degree to which body size, sex, age, and birth year (secular changes) influence the 3D rugose surface area of the biceps brachii insertion using a sample of 85 white individuals from the Robert J. Terry Collection. Enteseal surface areas were collected using a Nextengine™ 3D scanner. The goal of the study is to contribute to the understanding of the relationship between biological variables, activity and entheses morphology. Side-averaged results show that body size, as measured via the distal articular breadth of the humerus, accounts for 25% of the variation in male distal biceps enteseal area ($n=48$, $r=.504$) and 42% of the variation in female distal biceps enteseal area ($n=37$, $r=.646$).

The study sample was constrained to individuals aged 30 to 49. Even so, age-at-death explains approximately 33% of the variation in entheses size for males ($r=.577$) and 8% of the variation for females ($r=.284$). Initial correlation

results showed a strong relationship between birth year (range=1875-1934) and entheses size for both sexes; however, Terry Collection males are unequally distributed by age-at-death across birth years. When age-at-death is controlled for using partial correlations, secular change results for males are non-significant. Among females, year-of-birth explains 29% of the variation in rugose surface area once age-at-death is controlled for ($r=-.541$). Overall, size is the most significant variable for females, while age has a greater influence on 3D surface area of male entheses in this early 20th century American sample.

This study was funded by a California State University Mini-grant and the Sacramento Archaeological Society.

Having their cake and eating it, too: the role of dental specialization in saki feeding ecology.

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Primates in several radiations exhibit dental adaptations that enable them to gain access to seeds embedded in well-protected fruit. To a database drawn from published sources in which hardness of fruit and seeds were tested in the field using equivalent devices, we added an additional 100+ species of plants used as resources by pitheciin primates, specifically, South American white-faced sakis (*Pithecia pithecia*) and bearded sakis (*Chiropotes* spp.). This sample allowed us to compare hardness of fruit and seeds and deduce the relative incisive and masticatory functional capability of several primate taxa (New World monkeys, Old World monkeys, prosimians and chimpanzees). Average mechanical resistance values (kg/mm^2) of sakis (*Chiropotes* spp. and *Pithecia pithecia*) is equivalent to reported values of fruit opened by larger-bodied Old World seed predators—*Lophocebus* and *Cercocebus*. However, baboons and chimpanzees masticate seeds that are two to three orders of magnitude harder than sakis or mangabeys. In spite of their puncture abilities, approximately 40% of foods ingested by pitheciins were in the range of a ripe fruit eater (*Ateles paniscus*). This raises the possibility that pitheciins exemplify Liem's paradox, i.e., "that phenotypic specialization [is] not accompanied by ecological specialization" (Robinson and Wilson 1998:224). On the other hand, sakis appear to exemplify what most primates do well—respond flexibly to shifting resource types and availability. Saki/uakari dental specializations may enable them to have their cake and eat it, too.

Weighing the evidence: the significance of symbolic behavior among European Neandertals.

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With recent data from genetics, paleoneurology and life history studies strongly suggesting a close relationship between

Neandertals and modern humans a re-evaluation of their behavioral similarities and differences is warranted. I summarize the genetic, paleoneurological and life history data and briefly discuss new discoveries concerning Neandertal diet/ecology, geographic range and structured use of space to add context but focus on the evidence for symbolic behavior among Neandertals and modern humans in the MP and EUP. I discuss critically the evidence for burials, use of colorants, personal adornment, engravings, and other possible examples of symbolic behavior among each of these populations. Using GIS, I demonstrate that the appearance and continuity of symbol-based behaviors are at once richer in content but patchier in distribution for both of these populations. I conclude that time rather than species affiliation may be a better predictor of so called "modern behaviors." Thus, I argue that the material culture and lifeways of Late Pleistocene hominins must be understood as historically situated phenomenon. Perceived behavioral differences between Neandertal and modern human populations as well as the transition from the MP to the EUP are best explained with reference to social, demographic and cultural factors instead of, or in addition to, newly evolved biologically based cognitive mechanisms, as this is most parsimonious with the archaeological, genetic, paleoneurological and life history data. The results of this study will have important consequences for the development of evolutionary-based cognitive models that are more in step with current archaeological and biological data.

Long in the tooth: tracing migration using stable isotopes in dental enamel from Byzantine St. Stephen's.

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Stable isotope analysis of dental enamel is useful in investigating the geographic origins and migration patterns of ancient human groups. Both strontium (⁸⁷Sr/⁸⁶Sr) ($n=22$) and oxygen ($\delta^{18}\text{O}$) ($n=15$) isotope analyses were performed on samples from St. Stephen's monastery (5th-7th centuries AD), the largest monastic complex in Byzantine Jerusalem for approximately 100 years. Primary sources provide information on the identities of those who embarked on these journeys, indicating that many originated to the north and east of Palestine. Thus, it was expected that some of those interred at St. Stephen's were non-locals. This hypothesis was tested by evaluating local ⁸⁷Sr/⁸⁶Sr bioavailability, $\delta^{18}\text{O}$ values of regional precipitation, and the biogeochemical composition of enamel from the monks themselves.

⁸⁷Sr/⁸⁶Sr ratios of archaeological fauna revealed a mean of 0.70814 ± 0.00010 (2σ). Human ⁸⁷Sr/⁸⁶Sr values exhibit an average of 0.70843 ± 0.00069 (1σ) and are highly variable, ranging from 0.70763 to 0.71045. At least 50%

of these individuals fall well outside the locally defined range, indicating a considerable portion of those interred at the monastery were immigrants, and based on textual evidence, pilgrims to Jerusalem. Oxygen isotope results exhibit a similar pattern and confirm the geographic diversity of childhood residence among individuals. These isotopic data validate claims made in the textual record that pilgrims not only traveled to these monasteries from some distance, but that they also stayed. This also confirms St. Stephen's importance as an early Christian center.

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Immune and reproductive functions in female life history: how do we go about it?

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Most of the attention on the relationship between immune and reproductive functions in human females has focused on the immune aspects of the actual reproductive process or on how infection affects reproductive health, both within a clinical or public health context. The long term, developmental and evolutionary aspects of such relationship are less understood. The paucity of data, both in human and non-human primates, relate to the technical, theoretical and ethical challenges in the assessment of immune and reproductive functions at the individual and population levels. Recently however, new methodological and conceptual breakthroughs have been made which have propelled the study of the interactions between immune function and other life processes. The field is thus ripe for new hypothesis-led research aimed at understanding which and how ecological variables affect such interactions and in turn, result in population variation. In this paper, I will summarise the empirical evidence, discuss the theoretical and methodological challenges and identify questions for future research.

Do parasites constrain group size? A phylogenetic comparative study and meta-analysis.

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Living in a group has benefits, but also costs. Among these costs, parasitism has been viewed as a key constraint on group size. However, the association between group size and parasitism is remarkably variable. While some field studies find a positive link between parasites and sociality, others find a negative association; comparative studies have also been inconclusive.

To help resolve these conflicting results, we conducted phylogenetic analyses using data from within and across species. First, we used new phylogenetic comparative methods to assess the association between group size and parasite richness across species of primates. Using a Bayesian approach that controlled for phylogenetic uncertainty and incorporated phylogenetic signal, we failed to find a significant association between group size and parasitism.

Next, we systematically examined the association between group size and parasitism with meta-analysis techniques. Drawing on intraspecific and interspecific studies of 42 animal species, we found evidence for a positive relationship between group size and parasitism. However, the effect was weak and varied across studies and taxonomic groups. Vector-borne parasites showed the strongest association with group size, consistent with larger groups attracting more vectors. The pattern was considerably stronger in birds than in mammals, with mammals having an effect size that was statistically indistinguishable from zero. Phylogeny failed to explain significant variation in effect sizes.

Our analyses call into question whether group size is the main dimension of sociality that influences parasitism. Recent work instead suggests that intra-group contact patterns vary with group size and predict disease transmission.

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Mojokerto revisited: assessing brain growth patterns in *Homo erectus*.

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Brain development in *Homo erectus* is a subject of great interest. Some researchers have suggested that its brain development resembled that of nonhuman apes, while others argue for a more human-like growth pattern. In this study, we retested hypotheses regarding brain ontogeny in *H. erectus* using new methods (resampling), data from additional *H. erectus* crania and newly refined endocranial volumes for the Mojokerto calvaria. We assumed that the Mojokerto individual was between 0.5-1.5 years at death, and used brain sizes from similarly aged humans and chimpanzees. Our results reveal a considerable amount of overlap between chimpanzee and human brain development, with humans achieving 65% ($\pm 14\%$) and chimpanzees 81% ($\pm 12\%$) of brain growth by 6 months to 18 months of age. Mojokerto had reached 69%-73% of its adult volume when compared to all *H. erectus* crania ($n=22$). When compared to the most relevant specimens from Indonesian sites greater than 1.2 myr ($n=9$), Mojokerto had reached only 69% of its adult cranial capacity. Mojokerto thus falls within the range of both humans and chimpanzees, though slightly (but not significantly) closer to the average human pattern. These findings do not support the contention that *H. erectus* had rapid, ape-like

brain growth, and have important implications for considering the evolution of human childhood and cognitive abilities. We suggest that *Homo erectus* would have had a unique developmental pattern that should be considered as an important step along the continuum leading to extreme infant altriciality and long childhood in modern humans.

The timing of the onset and duration of perimenopause in baboons and humans.

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Several species of non-human primates show evidence of reproductive aging and menopause, indicating that the mechanisms underlying reproductive senescence are conserved in the primate lineage. The perimenopause is defined by the onset of irregular ovarian cycles and signifies aging of the reproductive axis, but little is known of the timing of this process in either human or non-human primates. We tested the hypothesis that the timing of this aging process is similar in baboons (non-seasonal breeders) and humans.

We used a Bayesian change-point analysis with longitudinal data on menstrual cycle lengths to identify the onset of irregular cycling, and length of time from this onset to menopause. Cycle lengths were calculated using prospectively recorded menstrual bleeds from 1) 41 captive baboons at the Texas Biomedical Research Institute for which we could confidently establish ages of perimenopause and menopause, and 2) up to 440 women born prior to 1939 who kept menstrual calendar cards for as long as 30 years as part of the TREMIN TRUST research program.

For the baboons we found that the time between a distinct change in cycle regularity and menopause was effectively a fixed quantity regardless of the age of perimenopause onset, and this duration of perimenopause is 4.5 years. Analyses of the TREMIN data are in progress. While there is wide individual level variation in the age at menopause, the duration of reproductive senescence leading up to the menopause is comparatively invariant.

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The emergence of the band in human social and cognitive evolution.

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A distinctive feature of human evolution is the emergence of the band in human society.

The band is an enduring fusion phase set within a wider pattern of fission–fusion social organisation, and lacks analogues in extant apes. It is, in effect, a durable social coalition of pair-bonded households embedded within the community. We investigate several lines of evidence in an attempt to pinpoint why and when bands crystallised in human evolution. Both brain size evolution and the evolution of the pair-bond appear intimately tied in this relationship. Our review revealed that an increased reliance on meat for caloric intake prompted changes to hunting and foraging strategies and, crucially, forced humans into living at lower population densities with new and different relationship demands. Brain size concomitantly increased. Solving the subsequent problem of maintaining non face-to-face long-distance relationships, and divergent close range ones, was achieved cognitively since cognitively-mediated behavioural flexibility is the least committing and fastest to evolve. We propose that ‘strong cognition’ (heavy mutual investment) was a product derived following the evolution of human pair-bonds. Extrapolating the pair-bond relationship to non-pair (i.e., band) partners ensured that bonds among the dispersed network of band members could be maintained in spite of potentially long periods of separation. We link the timing of these events to *Homo heidelbergensis*, common ancestor to *H. neanderthalensis* and *H. sapiens*, placing him as the most likely candidate for the stem hominin for band formation.

Making functional and dietary inferences using FEA: approximations in modelling.

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Finite elements analysis (FEA) is increasingly applied to fossils to infer function and so, aspects of ecology. Reliable assessment of masticatory system functioning and inferences about diet depend upon several things, including; quality of reconstruction of fossil material, correct construction of FE models, use of appropriate model parameters and, importantly, subsequent appropriate interpretation.

Here we assess the consequences for the functioning of FE models simulating biting in a macaque of modelling approximations and applied muscle forces. Previous FEA has shown the model predicts strains that closely replicate measured *in vitro* strains over the zygoma and infraorbital region. Using a novel combination of strain maps and geometric morphometric analyses of large-scale model deformations under loads we assess the impact of common approximations in model construction, constraints and loading. They show, for the most part, that the approximations are within acceptable limits and, where they are not, their effects are somewhat predictable. As such, they can be taken into account in assessing and comparing general patterns of deformation arising from FEA.

Thus, FEA is a robust and reliable tool for predicting general patterns of deformation of

this model during biting. The same is likely to pertain for other primates, including fossils, and so we can have confidence that comparative FEA studies of biting simulations among living and fossil primates may indeed reflect reality. However, a major challenge is to develop better understanding of what differences in masticatory load resistance among species might mean in terms of ecology and feeding behaviour.

The work has been supported by research grants from The Leverhulme Trust (F/00224), BBSRC (BB/E013805; BB/E009204), and by EVAN (MRTN CT-2005-019564). M.P. was funded by the Fundação para a Ciência e a Tecnologia (Portugal), through the Ph.D. Programme in Computational Biology, Instituto Gulbenkian de Ciência (Portugal).

The caloric and nutritional yields from insectivory for Kasekela chimpanzees.

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Insectivory is a potentially important source of protein, fat, minerals, and vitamins for chimpanzees. However, data on the intake rates of insect prey and their nutritional content are limited. Drawing on behavioral observations from 2008–2010 and previously reported assays, we provide macronutrient and mineral intake estimates for termite fishing (*Macrotermes*), ant-dipping (*Dorylus*) and ant-fishing (*Camponotus*) sessions by Kasekela chimpanzees.

Insectivory sessions ranged from <1 minute to almost five hours. Estimated caloric intake ranged from <1.0 - 286kcal per session. Fat and protein intake per session ranged from <0.01 - 1.35g and <0.25 - 40.8g, respectively. The estimated mineral intake from brief sessions was negligible, but yields from longer sessions approached or met human RDA requirements for some minerals. Ant-fishing yielded smaller amounts of energy, fat, protein, and minerals than ant-dipping or termite-fishing.

On a g ram-to-gram basis, the macronutrient values of Kasekela insect prey are generally comparable to published values for wild mammal meat. Compared to hunting, insectivory provides lower but more predictable yields (at least on a seasonal basis), lower energy expenditure and minimal risk of injury. We conclude that insectivory is a viable (albeit time-consuming) strategy for acquiring fat and minerals in nutritionally significant quantities for Kasekela chimpanzees.

Though Kasekela chimpanzees consume mammalian and insect prey year-round, there is substantial variation in patterns of faunivory within and between wild *Pan* communities. The nutritional significance of faunivory for *Pan* is ultimately best evaluated at the individual and community level, and in the context of the broader (and largely frugivorous) diet.

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Ecological risk aversion and juvenile ring-tailed lemur feeding ecology.

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The extended primate juvenile period is likely a result of the complex interaction between feeding ecology and sociality. The Ecological Risk Aversion Hypothesis (ERAH, Janson and van Schaik 1993) has contextualized juvenility as a strategic life history shift that minimizes both predation and starvation risk. While this hypothesis fits the developmental patterns of skeletal growth in monkeys and apes, behavioral support for the ERAH in these taxa has been mixed. Furthermore, the ERAH is not supported by skeletal and dental development in the strepsirrhine, but behavioral evidence is lacking. A mixed-longitudinal sample of feeding and foraging behavior gathered from ring-tailed lemurs (*Lemur catta*) at the Beza Mahafaly Special Reserve, Madagascar shows that, like many monkeys and apes, ring-tailed lemur juveniles show a mix of behavioral traits predicted by the ERAH, but in general do not meet the ERAH's predictions. Contrary to the ERAH juvenile ring-tailed lemurs do not show spatial patterning that would minimized predation risk (forage closer to conspecifics, forage in center of group), have higher dietary diversity, and are equally efficient at finding and eating leaves. As predicted by the ERAH, juveniles are less efficient than adult at processing fruits and feeding on flowers, and received more aggression than other group members. Using ring-tailed lemurs as an example it does not appear that lemurs show the same developmental tradeoffs as monkeys and apes, where ecologically risk averse foraging may have broader impacts on growth and development.

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Chimpanzee bipedalism: integrating experiments and musculoskeletal modeling.

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Chimpanzee bipedalism has long provided important context for understanding the evolution of human walking. However, previous studies of chimpanzee gait have been limited to two-dimensional measurements. Yet, it is well known that chimpanzee bipedalism involves exaggerated mediolateral movement as compared to humans, requiring substantial hip joint rotation and ab/adduction. In this study, we integrate experimental data with a musculoskeletal model of the pelvis and hind

limb to generate the first 3D kinematic analysis of the chimpanzee bipedal gait cycle.

Data were collected from three chimpanzees (*Pan troglodytes*) walking on two legs along an ~11 m runway. A four-camera motion capture system recorded the movements of joint and segment markers over a full stride (stance + swing). Marker data were integrated with scaled, subject-specific musculoskeletal models of the chimpanzee pelvis and hind limb, and used to solve for joint and segment angles via inverse kinematics in OpenSim®.

These data represent the first 3D kinematics for bipedal walking in chimpanzees, and provide functional estimates of muscle moment arms over the gait cycle. A model-based, inverse kinematics approach to determining joint motion may be less sensitive to skin marker errors than traditional approaches, as movements must conform to the underlying skeletal geometry. Further, this approach allows for tighter integration between inverse and forward dynamics analyses of locomotion.

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Odontometric variation among three ethno-linguistic groups from the rugged mountain highlands of Gilgit-Baltistan, Pakistan: testing historical hypotheses with tooth size allocation analysis.

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The Shin, Wakhi, and Burusho are ethno-linguistic groups found in the Gilgit-Baltistan province of northern Pakistan. Odontometric data collected from geographically distinct samples of Wakhis (n=326), Shins (n=333), and Burushos (n=284) are compared to test the claim of close biological affinities between members of high-status castes of north India and members of ethno-linguistic groups of northern Pakistan. This comparison further tests the reliability of historical, linguistic, and geographic criteria for predicting population affinities. Biological affinities of Gilgit-Baltistani highlanders are placed into wider perspective through comparison with 24 living and prehistoric populations from Central Asia, the Indus Valley, and peninsular India.

Maximum mesiodistal and buccolingual measurements were obtained for all permanent teeth except third molars in accordance with standardized methods. Individual measurements were scaled against the geometric mean to control for sex dimorphism and evolutionary tooth size reduction. Inter-sample differences in tooth size allocation were assessed with pairwise squared Euclidian distances and the patterning of phenetic affinities among samples was assessed with hierarchical cluster analysis, neighbor-joining cluster analysis, multi-dimensional scaling, and principal co-ordinates analysis. The results suggest that historical accounts, linguistic association and geographic location do provide meaningful indicators of biological relatedness among the living ethnic groups of the Gilgit-Baltistani highlands. The marked absence of close affinities between these living ethnic groups and archaeological samples from the Indus Valley confirms Hemphill et al's (2012)

assertion that many of the contemporaneous populations of the Karakoram highlands represent recent immigrants to the northwestern periphery of South Asia.

Ancient DNA perspectives on the peopling of South America.

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Studies of genetic variation in prehistoric populations (ancient DNA) are the natural linkage between archaeology and modern population genetics. Scores of recent aDNA studies have confirmed the antiquity of strong geographic structure in mtDNA variation in North American populations, but such patterning is less clear in South America.

There are significant mtDNA haplogroup frequency differences between coastal and highland populations in both prehistoric and modern South America. Additionally, mtDNA haplogroups A and B are rare to absent in the Southern cone of South America, but common in the north of the continent. Haplogroup A appears to have been introduced to Southern South America only after 3000 BP, while the status of haplogroup B in the south remains enigmatic. These coastal and interior continental contrasts are consistent with both archaeological and modern genetic data in North America that suggest a coastal entry into the Americas, and a different interior colonization process.

Paleoclimatic and paleoecological data suggest that Pleistocene South America was sufficiently ecologically distinct from North America as to imply a different set of processes for interior human dispersal and adaptation on the continent, resulting in unique population histories and patterns of genetic variation. As coastal routes of entry become more important to continental colonization models additional aDNA studies focusing on earlier prehistoric samples from the South American coast (North Pacific, Caribbean, South Atlantic) will yield more direct evidence on the timing and routes of entry into South America, and permit direct testing of alternative colonization models.

Genomic and metagenomic research with Peruvian indigenous communities.

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Peruvian indigenous communities represent an attractive target for genomic research. From local Peruvian researchers to large international efforts, research teams endeavor to fill the gap in existing genetic data from studying this part of the world. However, genetic studies of Peruvian natives raise many

questions about the appropriateness of this type of research. Peru, like many developing countries, is still in the early process of defining mechanisms for the protection of vulnerable communities.

It has been argued that genetic research in native communities is unethical and exploitative because it is led by questions that are relevant to the researchers and mostly irrelevant or even upsetting for the communities, in addition to producing benefits for the researchers and rarely for the groups studied. Yet, excluding native communities in genomic research will generate a larger health disparity if genetic data provides applications to improve human lives.

We present our experience engaging native Peruvian communities in genomic research, including the challenges we faced and the opportunities we discovered. We propose that elements of community based participatory research, from the initial consultation to the final review of manuscripts, will enable sensible research that incorporates the community priorities and concerns. Although there might be unclear normative framework that regulates research with native communities, both past and present, in developing countries, research can support local authority's efforts to develop this framework, which was our case when working with Instituto Nacional de Salud in Peru.

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Investigating causal relationships among morphology, kinematics and energetics of bipedal locomotion using musculoskeletal models: forward and inverse dynamic approaches.

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Understanding how differences in morphology and structure of musculoskeletal system affect mechanics and energetics of bipedal walking in human and non-human primates provides valuable insights towards clarifying the origin and evolution of human bipedal walking. However, elucidating the complete mechanisms of bipedal walking based solely on experimental analyses is not trivial. Therefore, we recently employ computational techniques to investigate causal relationships among morphology, kinematics and energetics of bipedal locomotion based on musculoskeletal models.

For forward dynamic simulation, we constructed a 2D neuro-musculoskeletal model of bipedal walking in Japanese macaque. We used phase oscillators as a model of spinal pattern generator. By optimizing the parameters defining the timing and magnitude of motor command send to each muscle such as to maximize walking distance and to minimize energetic cost of locomotion, continuous bipedal walking was successfully simulated. This approach allows complete prediction of locomotion based on a given musculoskeletal

model, but extension of this simulation to 3D is currently very difficult.

For this reason, we also used inverse dynamics analysis. An anatomically-based 3D musculoskeletal model was constructed and joint motions and ground-reaction-forces from experiments were input to estimate muscle forces and energetic cost of locomotion. Although kinematics of locomotion must be predetermined, this approach allows evaluation of effects of differences in musculoskeletal morphology on energetic cost of locomotion. Forward and inverse dynamic approaches have both advantages and disadvantages, but complementary use of two approaches could provide profound insights into the evolution of human bipedalism.

Ancestry and the osteometric assessment of the femur.

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Previous analyses examined the femur as an indicator of ancestry regarding anterior curvature of the diaphysis, torsion, and anterior-posterior flatness of the subtrochlear diaphysis. While showing promise, the first two attributes lack quantitative means of comparison and focus on differences between European and African ancestry. The latter focuses primarily on comparisons of European Americans and Plains Region Native Americans. We hypothesize that there are ancestral differences in the femur and that these differences can be examined metrically through the minimum superior-inferior diameter of the femoral neck and ratios calculated from the minimum diameter anterior-posterior of the diaphysis divided by the maximum diameter of the diaphysis along the linea aspera. This study employed measurements gathered from Hamann-Todd, Terry, JPAC-CIL, and Goyang Collections (total n=104), combining sexes. JPAC-CIL, Terry and Hamann-Todd Collections are composed primarily of European and African Americans, while the Goyang Collection is composed of entirely of Koreans from the Joseon dynasty (1392-1910). Initial statistical analyses (SPSS v.19) using discriminant analysis comparing European and Asian ancestries reveals anterior-posterior diaphysis measurement ratios and diameters of the femoral neck correctly classify European individuals with >87% certainty and Asian individuals with >83% certainty yielding an overall classification around 86.5%. Results suggest that the femur can be metrically assessed to determine ancestry and could be developed further to include three main ancestral groups present in the United States today. Additional analyses are planned that will include discriminant analysis to develop models for European vs. Korean, and European vs. African ancestries, while accounting for sex.

Secondary ritual or peri-mortem body manipulation during early Holocene in South America: the case of Burial 21 from the site of Lapa do Santo, Lagoa Santa region, Brazil.

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The mortuary practices of early Archaic groups that inhabited South America are still largely unknown. Recently, however, due to the presence of many disarticulated burials on sites of this time frame, some authors have suggested that the manipulation of the dead body was a common practice. Notwithstanding, in many cases the evidence available is scarce and fragmentary. A very elementary issue of equifinality is in part responsible for this scenario. Even when taphonomic factors can be peremptorily rejected, it is not straightforward to determine if the disarticulation was a product of peri-mortem or post-mortem intervention of the funerary agents. From an anthropological point of view this reflects the important difference between rituals of secundarization (*sensus* Hertz) and rituals involving the manipulation of the fresh corpse. Here we describe the case of Burial 21 from Lapa do Santo, a new site in the region of Lagoa Santa (central Brazil). Stratigraphically dated to 8500 yBP, this articulated skeleton had its two legs cut and removed before any significant decomposition of the soft tissues. Constitute, therefore, an indisputable case of early Holocene peri-mortem body manipulation in South America. From a regional perspective this burial is also particularly important since it constitute a link between the articulated and non-articulated burials long known to occur in Lagoa Santa region between 8000 and 9000 yBP. It is now clear that those different burials didn't represent the existence of different groups in the region, but were in fact part of one coherent multi-stage funerary ritual.

Scat-detecting dogs as effective means to locate fecal samples from unhabituated primates.

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The difficulty of acquiring scat samples from unhabituated primates has long hindered the range and scope of genetic and endocrinological studies of free-ranging primates. While scat samples can be collected from well-habituated primate groups with relative ease, it is often impossible when reclusive and arboreal primates scatter upon human presence, have poorly known distributions, or occupy large home ranges in arduous terrain. As a result, few population genetic studies of free-ranging primates have

adequately sampled broadly distributed populations of unhabituated primates.

Recently, scat-detecting dogs have been used successfully to locate and identify target feces during surveys of rare mammals; however, this technique has never been applied to primates. We acquired a pedigreed Belgian Malinois from the Police Dog Training Base of the Chinese Ministry of Security. With three months of modified narcotics and search-and-rescue dog training in Kunming, we taught the dog to identify scat samples from black crested gibbons (*Nomascus concolor*) and Phayre's leaf monkeys (*Trachypithecus phayrei*). During the initial five months of fieldwork in Yunnan Province, China (Wuliangshan and Yongde Daxueshan National Nature Reserves), we identified 104 putative scat samples of various ages from the two species of interest. Fecal samples were collected from the forest floor using the two-step EtOH/silica method and stored at room temperature for up to two months at room temperature before freezing at -30 °C or -80 °C. DNA barcoding of the mitochondrial D-loop confirmed the accuracy of this method.

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Kinematics and morphometrics of the radiocarpus in anthropoids with implications for reconstructing the evolution of hominin wrist mechanics.

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African-ape-like characters of the early hominin distal radius have been argued to support the knuckle-walking ancestor hypothesis. Features including a distally projecting dorsal ridge and dorsally-oriented scaphoid notch are thought to effect rapid close-packing of the radius and proximal carpal row, which limits radiocarpal extension. That functional model is tested using a combination of computed-tomography-based carpal kinematic analysis in cadavers and morphometrics based on point-digitized landmarks of dry bones. The kinematics indicate that radioscaphoid rotation reflects the overall extension of the radiocarpal complex, and CT imaging demonstrates that the dorsal lip of the scaphoid notch on the radius demarcates maximum extension. Chimpanzees are only slightly less mobile at the radioscaphoid joint than orangutans, but palmigrade-capable monkeys exhibit considerably greater mobility and match published values for humans. Morphometrically, only *Pan* and *Hylobates* differ significantly amongst apes in the relative projection of the scaphoid notch's dorsal lip (*Pan* > *Hylobates*), while all apes differ significantly from humans (apes > humans), which are most similar to the monkeys in this metric. Therefore, radiocarpal morphology restricts mobility in apes vis-à-vis humans and monkeys, but this is probably an artifact of anatomy that accommodates reaction forces arising during climbing and suspensory hand postures rather than having evolved specifically as a knuckle-walking adaptation. As such, the ape-like radiocarpus of early hominins indicates

limited proximal-carpal extension, but not necessarily plesiomorphic retention from a knuckle-walking ancestor. Epiphyseal reorientation (and consequently higher radiosaphoid mobility) in later hominins is probably due to infrequent arboreality and/or selection for enhanced manipulative capabilities.

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Socioeconomic status and duration of breastfeeding explain childhood adiposity in boys but not girls.

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Adiposity during childhood may be associated with poor health throughout adulthood. This complex trait is influenced by intrinsic and extrinsic factors throughout life. Our objectives were to examine the relationships between childhood adiposity, anthropometric, sociodemographic, and life history variables.

We collected anthropometric data (stature, weight, digit length, waist circumference, MUAC, abdominal and triceps skinfold) in children ($n = 55$) from elementary schools in Lincoln, NE. Parents were surveyed regarding life history (maternal age at menarche, subject birth weight and length, maternal and paternal height, duration of breastfeeding), education, household structure, diet, and general well being of their child. Percentages of children on free lunch were used as a proxy for socioeconomic status (SES) and subjects were classified dichotomously. Bivariate correlations and regression were used to explore relationships between variables. The Mann-Whitney U and Kruskal-Wallis tests were used to investigate differences between groups ($\alpha = 0.05$).

Results indicate that measures of adiposity during childhood are significantly lower in high rather than low SES families and duration of breastfeeding was negatively associated with childhood adiposity, but this was only true of males. Significant associations between 2D:4D asymmetry and some measures of adiposity in males and females were present and unexpected. Results for adiposity by SES are consistent with prior research and are likely due at least in part to unequal access to appropriate nutrition. Duration of breastfeeding has been associated with decreased adiposity, though our results suggest this is only true for males. Further research is needed to clarify these relationships.

This study was supported by the Layman Award and UCARE funding through the University of Nebraska-Lincoln.

Sexual dimorphism of the bony labyrinth in modern humans: a pilot study.

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Sex estimation in forensic or archaeological settings is often difficult due to the commonly fragmented state of human remains. We aim to assess the feasibility of estimating sex by metric analysis of 3D reconstructions of the bony labyrinth of the inner ear, a structure that completes growth before birth and preserves well under harsh taphonomic conditions.

A sample of 52 cranial Computer Tomography scans from a Cretan known-sex population was used to create 3D reconstructions of the bony labyrinths using the AMIRA software package. Measurements of the height and width of the semicircular canals and cochlea were taken following Spoor (1993). Indices of the height divided by width were also calculated to test for differences in shape. Subsequently statistical analysis was conducted with SPSS 14.

All measurements except the lateral canal width, right cochlea width, and the height and width of the left cochlea demonstrated significant dimorphism. Bilateral asymmetry was also tested and found to exist in the cochlea and semicircular canals. Discriminant functions were created to sex unknown individuals. Univariate equations yielded a maximum cross-validated accuracy of 76% and multivariate analysis improved accuracy to almost 79%.

Thus developing discriminant function equations for sex estimation this structure would allow for the same standards to be applied to individuals of any age. Although sample size is small, this 3-D reconstruction technique appears to have great potential for the sexing of fragmentary remains and individuals of uncertain age.

This research was supported by the Institute for Aegean Prehistory.

Developing research oversight processes for a Native American community.

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Despite negative publicity generated by the Havasupai Tribe's recent lawsuits, a great deal of biomedical research is taking place in Native American communities in the southwestern U.S. Many Native communities are reluctant to engage in any genomics research, or in any research for which biological specimens will be taken. To protect their interests, NA communities have begun asserting explicit ownership over research data. Communities are also developing their own research oversight processes. This presentation will describe ongoing work to help a southwestern Tribe develop a research oversight process. It will describe steps taken to develop expertise and institutional capacity for research review, and the steps taken to develop substantive principles for review. Furthermore, the presentation will highlight the ways in which community politics and relationships are shaping various choices in this project.

Funding provided by the Hopi Tribe.

Using musculoskeletal simulations to model the cost of locomotion: the OpenSim experiment.

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Many extinct hominins lack a modern analogue for their morphology. By definition hominins are terrestrial bipeds, but the nature or style of the bipedalism that characterizes the many extinct species remains an area of considerable and ongoing contention. Even more contentious is what that style might tell us about the species' adaptation. These issues persist in part because no consensus has been reached on the method for evaluating the cost of locomotion of creatures that cannot be observed.

One possible method that has become available in the last decade is creating detailed musculoskeletal simulations. These simulations can be validated against observed behavior and then modified to depict any form. The power of these models has, however, been tempered by the initial investment required: commercial software packages are expensive and freeware generally has a steep learning curve to overcome before implementation. Recognizing that this initial investment has kept many researchers from using musculoskeletal models, the NIH has funded the creation of a free musculoskeletal modeling system, called OpenSim.

We reported herein on the ability of OpenSim to simulate the walking patterns of 15 women, whose 3D gait characteristics and energy expenditure were measured using commercial hardware and software. Six months into the project, we have produced OpenSim simulations that faithfully replicate the observed kinematic and kinetic patterns of our subjects. The next step is to investigate muscle forces and activations. From our initial experience, OpenSim appears to offer an exciting new platform to simulate the morphology of extinct bipeds.

Secular changes in discrete dental traits on three continents.

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Secular changes in the dentition have been examined in terms of tooth loss, tooth size, and other features affecting mastication, but discrete dental traits rarely have been investigated to date (Edgar 2004, 2009).

The ASU dental traits were recorded from over 1800 Africans, Europeans, and Americans dating from the 9th to the 21st century, with a concentration of individuals after 1600. Samples originated in western Africa, western and central Europe, and diverse archaeological sites and collections in the US. Combinations of dental trait scores were analyzed as dichotomized and polychotomous variables using correlations, principal components, canonical variates analysis, and cluster analysis

using R (R Development Core Team 2009) and Fordisc 3 (Jantz and Ousley 2005). All necessary statistical assumptions were tested for each method.

Numerous analyses were run using various time, trait, and sample divisions, and several results were consistent in virtually all multivariate analyses: There are significant differences among all continental groups; the African and European groups changed the least over time, the African-Americans changed a bit more, but the Euro-Americans changed the most of all groups, and in one direction; all groups changed in different ways. Year of birth was significantly correlated with a smaller hypocone, metacone, protocone, and trigonid crest in Euro-American molars (adjusted $p < 0.01$); in African-Americans, only the hypocone became smaller, but the number of lingual cusps on the second mandibular premolar decreased, the mandibular first molar Y-groove pattern increased, and distal accessory ridges on mandibular and maxillary canines became more common.

Genetic variation in Mi'kmaq populations from Nova Scotia and its implications for the history of Algonquian populations in northeastern North America.

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The Mi'kmaq are a First Nations people from northeastern Canada who traditionally lived in seven distinct territories extending across the Atlantic Provinces. At the time of European contact, they were allied with several other Algonquian speaking tribes, including the Abenaki, Penobscot, Passamaquoddy and Maliseet, and later fought French and British control of their homeland. Yet, despite archeological evidence for human occupation of the region by 10,000 YBP, the origins and genetic affinities of Mi'kmaq populations are not well understood. To clarify their history, we analyzed mtDNA and Y-chromosome variation in two Mi'kmaq First Nations communities from Nova Scotia. We directly sequenced the control region in mtDNAs from 23 individuals, as well as screened them for eight coding region SNPs using Custom TaqMan assays and PCR-RFLP analysis. We also screened eight Y-chromosome samples for over 30 SNPs and a panel of 19 STRs using custom ABI TaqMan assays, multiplex indel/STR markers, and the AmpFSTR YFiler kits. Our results show that the majority of individuals (60.9%) have mtDNAs belonging to Native American haplogroups A2, B4, C1, D1 and X2, with remainder being of non-native origin. However, only one male had a Y-chromosome belonging to an indigenous haplogroup (Q). These data, viewed in the context of genealogical, ethnographic, and historical information from the Mi'kmaq First Nations, provide new details about the history of Mi'kmaq populations in

Nova Scotia, their genetic relationships with other Algonquian populations in northeastern North America, and the impact of European colonization on their genetic diversity.

This study was funded by the National Geographic Society, IBM, the Waitt Family Foundation, and the Department of Anthropology at the University of Pennsylvania.

The aetiology of oral disease: a differential diagnosis based on the mainland Southeast Asian experience.

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Discussions of the aetiology of oral disease in the bioarchaeological literature have often been contextualised within regional and global models of diet and/or subsistence behaviour: e.g., decline in oral health with the adoption/intensification of agriculture. In recent years there has been a push to include demographically driven factors: e.g., deteriorating oral health with increasing fertility. With so many competing aetiological factors it seems time to return to the case by case differential diagnosis when weighing contributory factors to oral disease. This approach is explored with respect to the patterning of oral health seen in a range of Neolithic to Metal Age Mainland Southeast Asian assemblages. It is concluded that in understanding the underlying causes of poor levels of oral health, seen in the earliest (initial Neolithic) assemblages in the region (e.g., caries rates in excess of 10% by tooth count), a range of factors have played a significant role: cariogenicity of rice vs. root crops, food processing (and storage) behaviours, local geochemical conditions, base line community health (elevated levels of cribra orbitalia and linear enamel hypoplasia characterise these early assemblages) and elevated rates of fertility (15P5 values in excess of 25%). Importantly, no one factor would seem to account for poor oral health during the initial Neolithic in Southeast Asia, making it difficult to use oral health as a proxy for any single human behaviour.

New population estimates of Pagai Island, Mentawai, West Sumatran primates.

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The four primates that inhabit the Mentawai Islands - Kloss's gibbon (*Hylobates klossii*), the Mentawai pig-tailed macaque (*Macaca pagensis*), the Mentawai Island leaf langur (*Presbytis potenziani*), and the simakobu monkey (*Simias concolor*) - are endemic and endangered. In this study, previous estimates of the population sizes of these primates on two islands - North Pagai and South Pagai - were revised. Forest cover was determined by using Google Earth Pro composite satellite imagery, which recently was updated (Google 2010). Forested areas were differentiated from

unforested and developed areas by color (dark green vs. lighter hues). The forested sections were outlined with the Google Earth Pro polygon tool, and the areas of the polygons were calculated to one hundredth of a unit. This information was used to compute the amount of remaining forest on each island.

To calculate population estimates, the average densities of each species (from Paciulli 2004) were multiplied by the amount of forested area. This yielded an estimate of the total number of individuals on each island. The estimates for the two islands were added together to obtain population estimates for both islands. The results indicate that there are approximately 299 Kloss's gibbons, 2276 pig-tailed macaques, 440 leaf monkeys, and 954 simakobu on the Pagai Islands. These numbers, when compared to previous population estimates of the Mentawai primates, demonstrate drastic reductions in population sizes. One of the most obvious reasons for this decline appears to be considerable habitat loss.

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Investigating hominin paleohabitats using fossil rodent ecomorphology.

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The taxonomic composition of fossil rodent assemblages from hominin sites can be used to infer paleohabitat structure. However, much of the fossil rodent material recovered is non-diagnostic or too incomplete to allow reliable taxonomic assessment, as is the case with the abundance of isolated fossil incisors that often confronts researchers. Thus, an ecomorphological, taxon-free method of investigating fossil rodent habitats would greatly augment our ability to utilize rodents for paleoenvironmental reconstruction.

Croft et al. (2011) [*J Mammal* 92:871-879] outline methods by which upper incisor morphology can be used to predict dietary preferences among caviomorph rodents. Using these methods, we have demonstrated that extant South African rodents can also be successfully partitioned into distinct ecomorphological categories. However, the application of these methods to the fossil record becomes more difficult because the necessary morphometric measurements require that the incisor be positioned correctly within its alveolus. Due to diagenesis and the inherent fragility of rodent crania, this positioning can rarely be determined even when the fossil incisor is still articulated with the premaxilla. To better the applicability of such ecomorphological approaches, we have been developing new measurements specific to isolated incisors and hemimandibles. Here we discuss these methods and their utility with material from Sterkfontein, Swartkrans and Gladysvale.

Postcanine tooth size and metabolic requirements in primates.

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We show the results of a study in which the relationship between postcanine tooth occlusal area (PCOA) and basal metabolic rate (BMR) has been evaluated in 28 primate species. On the one hand, the results obtained indicate that there is a high correlation between the BMR and the size of the PCOA, even when phylogenetic control tests are used, and that isometry cannot be discarded in both cases. However, if the effects of body mass are removed, a null slope cannot be discarded. On the other hand, when body mass (BM) is taken as the independent variable and PCOA as the dependent one, the slope obtained evidences a negative allometry, and this holds also when phylogenetic control is used.

Given these contradictory results, we suggest that the rule of "equivalence between exponents" (i.e., if the exponent is close to 0.75, a metabolic function is deduced) is not a good approach for obtaining inferences on the function of postcanine teeth. The argument for the existence or absence of a given relationship between two variables is based on the p value used for testing the null hypothesis H_0 ($\beta_1=0$), which is independent of the value taken by the slope of one of these variables when regressed on a third one. A different issue is if we wish to deepen on the relationship between the changes in PCOA and BMR, a task that needs evaluating the value obtained for the slopes. In any case, BM emerges as a key factor in such relationship.

Hardness testing of primate dentine.

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Recent research on tooth crown fracture mechanics has focused on the material properties of food items and primate oral anatomy. Dentine is a structurally and functionally important component of primate teeth; however, few studies to date have investigated the mechanical properties of dentine across the primate order. Such data are of interest to studies of masticatory functional morphology because of dentine's presumed role in dissipating masticatory stresses.

We investigated material anisotropy and regional differences in dentine stiffness, by collecting hardness data for the dentine of *Macaca fascicularis*, a model taxon for studies of in vivo masticatory biomechanics. Molars from three individuals were sectioned in coronal and transverse planes, and the cleaned and polished surfaces were sampled via Knoop and Vickers microindentation.

Our results show that molar dentine of crab-eating macaques is not significantly orthotropic ($p=0.123$), nor does it exhibit in-

plane anisotropy (Coronal $p=0.705$, Transverse $p=0.096$). This apparent material isotropy exists despite the presence of significant structural heterogeneity (i.e., the presence and orientation of dentine tubules, and peritubular/intertubular dentine differences). Under the assumption that dentine hardness is proportional to its stiffness, these findings have significant implications for constructing models of tooth function and interpreting patterns of enamel fracture.

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Bachelor gelada association and ranging patterns: implications for multi-level societies.

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In female-philopatric social systems, strong social bonds among males are rare. Additionally, male dispersal poses a problem for understanding how male association and ranging patterns change as they transition between life-history stages. Geladas (*Theropithecus gelada*) are rare among Cercopithecin primates in that they live in a multi-level society where all-male bachelor groups loosely associate with reproductive units. However, it is unclear if bachelor groups represent a true module within the broader gelada social system. Here, we examine the association and ranging patterns of bachelors and reproductive units. First, we show that bachelor groups are stable, closed social units. Second, we demonstrate that association indices between bachelor groups and reproductive units are lower than between reproductive units within the same band. Finally, we show that bachelors range over a greater area than reproductive units. These results suggest that bachelors serve as a link between gelada bands and facilitate gene flow across different bands.

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Estimating the evolutionary history of Southeast Asian Ovalocytosis.

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Southeast Asian Ovalocytosis (SAO) is a twenty-seven base pair deletion in the eleventh exon of the SLC4A1 gene that confers strong protection against falciparum malaria. This study examines the age of SAO in human populations from Southeast Asia and Melanesia (SAO's geographic range) by observing the amount and pattern of variation among SAO chromosomes. We collected both diploid and haploid polymorphism data by amplifying a 5,000 base pair region up- and down-stream of the SAO mutation, and then experimentally phasing the alleles using allele-specific primers. We observe

substantial genetic diversity among SAO chromosomes, suggesting that it may be a relatively ancient allele in comparison to the other malarial-resistant alleles studied thus far.

Funding for the project was provided by Northern Arizona University and the National Science Foundation (BCS-1062258).

Out at night: does moonlight or mating have a stronger effect on nocturnal ranging in the ring-tailed lemur, *Lemur catta*?

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Among nocturnal and cathemeral primates, moonlight increases nocturnal activity in many, but not all, species (Nash 2007). This study investigated the relative effects of moonlight versus mating on night ranging behavior in ring-tailed lemurs. Although this strepsirhine has traditionally been considered diurnal, recent work has demonstrated that ring-tailed lemurs can show nocturnal ranging during mating periods (Parga 2011). In this study, 6 ring-tailed lemurs from 3 social groups on St. Catherines Island, Georgia, USA were fitted with GPS (Global Positioning System) collars that collected location data once every 30 min. The lemurs were collared during a full moon (several days before the start of mating) in October 2010, and the collars were removed approximately 3 weeks later. To collect data on mating during the collar deployment period, daily dawn to dusk observations were conducted. Results revealed that night (between 1900-0530) ranging distances in the pre-mating period during peak moonlight (90-100%) were significantly longer than distances traveled during the mating period (Mann-Whitney: $p<0.05$), when the fraction of moon illuminated steadily decreased from 83 to 0%. Furthermore, across the study period, total distance traveled per night positively correlated with the fraction of moon illuminated (Spearman: $p<0.0001$). In conclusion, as is the case for many cathemeral primates, moonlight stimulates night activity in ring-tailed lemurs. Moreover, moonlight has a stronger positive effect on night ranging than does mating activity. These data provide further evidence of night ranging in this species, strengthening the suggestion that the ring-tailed lemur should be classified as a cathemeral strepsirhine.

Transitions in mortality and documented causes of death: North Orkney (1855-1955).

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While investigations into historical mortality patterns are important for anthropological and historical demography, they are plagued by several potential problems. Mortality is frequently the result of multiple competing causes, however vital records typically list only one cause. Many important causes go unnoticed, sometimes because they

had not yet been identified by medical science among other reasons. Furthermore, the names of medical conditions have changed over time. For example, what we now call tuberculosis has also been known as phthisis and consumption. Here we investigate patterns in listed causes of death over the span of a century in North Orkney, Scotland. While our population appears to follow the general epidemiological transition model, with noninfectious causes (e.g., cardiovascular disease and cancer) replacing infectious disease over time, the decrease in infectious disease coincides with a decrease in missing and unknown causes of death in the vital records. Some of the most distinct patterns for single causative agents appear in tuberculosis deaths. These dynamics may be related to the absence or presence of medical personnel and and/or to the discovery of the causative agent of tuberculosis in 1882. While our study has empirical significance in describing mortality changes in a historical population, it also has methodological relevance for other scientists who are interested in historical demography. Specifically, we show that transitions in mortality patterns also coincide with increased knowledge about diseases and transitions in nomenclature. These complex dynamics warrant further study and should be taken into consideration in historical studies of mortality.

Dental Modification in a prehistoric Chamorro Population from Tumon Bay, Guam.

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Dental modification is found in various populations around the world; however, it is rare in the Mariana Islands. A Chamorro population from Guam yielded a large number of individuals that span the island's two prehistoric time periods, the Pre-Latte and Latte, allowing for a diachronic study, which due to poor preservation and small samples, was not previously possible in Guam.

The Pre-Latte population (n = 104) is identifiable by a relative absence of betel nut staining which is seen in only 5% of the population. Additionally, dental incising is rare and seen in one individual. The Pre-Latte dentition displays abrasion on the labial surface of the maxillary dentition in 48% of the population and is not sex specific.

More than half, 64%, of the Latte individuals (n = 111) exhibit betel nut staining. Dental filing occurs in 6% of the population, and while rare, appears in various forms including: cross-hatched, parallel vertical lines, diamond pattern, and trapezoid pattern. Dental abrasion is only found in two individuals.

Analysis of these populations shows obvious cultural changes that occur over time. The Pre-Latte population can be characterized as one in which a repetitive task-related pattern creates labial abrasion. This activity is mostly abandoned in the Latte Period, where dental incising combined with betel nut chewing is dominant. Such differences in the dentition demonstrates a shift in behavioral patterns over time and may also be useful in delegating skeletal elements to the appropriate time period

when stratigraphic information is not available or lost.

Designing a hierarchical probe assay to identify native specific Y haplogroups in admixed populations.

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Major Y chromosome haplogroups are identified using both STRs and SNPs. However, STRs and haplogroup predictors are unreliable for identifying major Y haplogroups, especially those common in the Americas. Y chromosome SNPs identified by the YCC are a much more consistent means of identifying Y chromosome haplogroups. Identifying these SNPs usually requires costly and/or time consuming methods, such as sequencing, SBE, or RFLP. The cost and time are inflated when dealing with populations which have undergone significant admixture, such as those found in the Americas. Efficient and reliable techniques for Y haplogroup identification are needed, and ones for which cost is not prohibitive for smaller anthropological laboratories. A method is described here using a new probe technology, Hybeacons[®] (Evogen, Inc.), which addresses these needs. In order to save time and cost, a hierarchical multiplex was designed to first identify major global haplogroup/macrohologroup in three separate reactions (A, B, C, D/E, F; G, H, I/J, K; and L, M, N/O, Q, and R), then two singleplex reactions are performed to identify Native American specific SNPs (Q1a3a-M3 and C3b-P39). The multiplexes were authenticated on admixed populations from Europe, Africa, Asia, the Caribbean, and North, Central, and South America. The results were consistent with those obtained from independent sequencing of a subset of samples from each marker. The SNP multiplex provides a low-cost and rapid method for the typing of Y chromosome haplogroups important for any field whose data are dependent on identifying ancestry of male participants.

The utility of latent class analysis to estimate sex for populations of human skeletal remains.

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This presentation will demonstrate the utility of latent class analysis (LCA) for estimating sex from large samples of human skeletal remains. Accurately estimating biological sex from the human skeleton can be

especially difficult for fragmentary or incomplete remains often encountered in bioarchaeological contexts, what Konigsberg and Frankenberg (2007) refer to as "paleodemography under duress". Where typical anatomically dimorphic skeletal regions are incomplete or absent, observers often take their best-guess to classify biological sex. LCA estimates the probability of membership in each latent class from observed relationships between a set of indicator variables. In this study, sex is the latent variable (male and female are the two latent classes), and the indicator variables used here were eight standard linear measurements (Buikstra and Ubelaker 1997). Mplus (Muthen and Muthen 2010) was used to obtain maximum likelihood estimates for latent class membership from a known sample of individuals from the Forensic Databank (FDB) (Jantz and Moore-Jansen 2000) (n=1831), yielding 87% correct classification for sex. Then, a simulation extracted 5000 different random samples of 206 complete cases each from the FDB (these cases also had known sex). We then artificially imposed patterns of missing data similar to that observed in a poorly preserved bioarchaeological sample from Medieval Asturias, Spain (n=206), and ran LCA on each sample. This tested the efficacy of LCA under extreme conditions of poor preservation (42% missing data). The simulation yielded an average of 82% accuracy, indicating that LCA is robust to large amounts of missing data when analyzing incomplete skeletons.

Sexual dimorphism in the lower vertebral column: a discriminant function analysis using contemporary skeletal series.

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This presentation expands on an earlier (2005) study that developed methods for sex assessment from twelfth thoracic (T12) and first lumbar (L1) vertebrae. Two contemporary skeletal collections (Dart, Maxwell) were used to evaluate population variation in vertebral dimorphism shown originally for older samples (Spitalfields, Terry).

A suite of metric characters consisting of fourteen diameters and dimensions was examined, including height and diameters of the vertebral body, and dimensions of facets and processes. The Dart sample (University of Witwatersrand) of 20th century South African Blacks consisted of T12/L1 vertebral pairs from 51 male and 51 female skeletons, while a smaller sample (24 males, 15 females) of contemporary European/Americans was measured from the Donated Forensic Collection of the Maxwell Museum (University of New Mexico). Significant sex differences were determined for 13 traits in T12s and 12 traits in L1s from the Dart sample (p < 0.05 to 0.001); and for 9 variables from Maxwell T12 vertebrae.

Not unexpectedly, equations developed in the original study performed poorly for sex attribution when tested on the more modern samples. Consequently, new discriminant functions were developed and evaluated. The results showed significant sex differences for both vertebrae in the Dart and Maxwell samples. Using T12 for example, Black males and females from the Dart collection were correctly sexed

approximately 90% of the time using one to three measurements. Discriminant analyses of the Maxwell male and female sample yielded similar results although at slightly lower accuracies. These results confirm high dimorphism in the lower vertebral column.

Electromyography of pedal and crural muscles in *Cebus apella*: implications for the evolution of the anthropoid grasping foot.

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A foot capable of strong grasping with an opposable hallux has been recognized as an important adaptation in euprimate evolution. Along with relatively long lateral toes, 'prosimians' have morphological adaptations in their first metatarsal (Mt1) and Mt1-entocuneiform joint that reflects their ability to abduct/adduct their hallux through a large range, thereby allowing them to effectively utilize small-diameter substrates. In fact, electromyography studies in lemurs and lorises show that the extrinsic toe flexors and the intrinsic hallucal adductor are recruited more when using small diameter supports compared to when walking on large branches. In contrast, anthropoids tend to have relatively shorter lateral toes and a hallux that likely has a smaller range of abduction/adduction, based on morphological comparisons. This would suggest that pedal grasping capabilities in anthropoids are reduced, and their feet are more suitable for locomotion on large-diameter supports. To test this hypothesis, we analyzed new electromyography data from the adductor hallucis, flexor digitorum fibularis, flexor digitorum tibialis, peroneus longus, and peroneus brevis of two capuchin monkeys (*Cebus apella*) walking on both wide and narrow diameter supports. As documented in lemurs and lorises, our results show that capuchins increase recruitment of their adductor hallucis, but not peroneus longus, during narrow branch locomotion. However, in distinction to prosimians, capuchin toe flexors do not substantially increase in activity on narrow substrates; in fact, flexor digitorum tibialis is not particularly active during walking regardless of substrate size. These results demonstrate fundamental similarities and differences in pedal grasping mechanics among prosimians and anthropoids.

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The influence of grandmothers on postpartum health of mother and infant.

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The 'grandmother hypothesis' proposes that the adaptive advantage for post-menopausal longevity in humans is the presence of grandmothers to provide high quality care for

grandchildren, resulting in improved reproductive success for both lineages. Recent studies have shown that a grandmother's increased longevity, however, may be related to fewer grandchildren, and that her presence might increase infant mortality.

Building on previous studies focused on mortality and birth rates, we looked specifically at how grandmothers affect postpartum mother and infant health within four-to-six weeks after the birth of a healthy term infant. To assess the health of the mother, we conducted interviews with postpartum women in the northwestern United States and had participants fill out the Edinburgh Postnatal Depression Scale (EPDS). To measure infant health, we collected mother-reported data on the frequency of visits to a health care provider and infant illness, and when possible we collected data on infant feeding patterns and growth and development history. To assess the involvement of grandmothers, we utilized interviews and questionnaires, including a modified Mother-Adult Daughter Questionnaire.

Preliminary results indicate that the grandmothers' involvement postpartum affects both the mother's and the infant's overall health; however, confounding variables include the mother-daughter/daughter-in-law relationship prior to the birth of the infant, the intensity of the grandmother's involvement postpartum, and the relationships between multiple grandmothers and other support systems. We discuss how the outcomes reported here and in the literature might translate into understanding the role of grandmothers in human evolution.

Human dimensions of primate conservation, with a focus on field work with Neotropical Primate Conservation in Peru.

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Human views of and relationships with nature differ greatly across the board, and must be thoroughly examined to develop conservation strategies in today's increasingly globalized world. Based on knowledge gained while volunteering in community conservation efforts for Neotropical Primate Conservation (NPC) in Peru, as well as on independent study, I identify mining, modern export agriculture, logging, and bushmeat as the greatest threats to primate survivability today, and analyze each one's significance from social, political, and conservation standpoints.

In light of the interconnectivity between conservation needs and the needs of human communities, primate conservationists would do well in turning to community conservation to find long-term, sustainable solutions. I cite NPC's efforts as an example of how all of the previously identified problems can be approached by integrating and empowering communities and mediating between those communities and governments. But just as importantly, conservationists need to reach beyond local efforts, educating the people of Western nations on the far-reaching effects of their choices as consumers, as well as holding international corporations accountable for the exploitation and abuse of human groups and vulnerable ecosystems.

Biological and spatial structure of an Early Classic Period cemetery at Charco Redondo, Oaxaca.

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In the spring of 2011, archaeologists identified two unique contexts in an Early Classic cemetery at Charco Redondo, Oaxaca. The cemetery included spatially distinct areas: Context 1 (n=20) and Context 2 (n=3). Context 2 differed from Context 1 in stratigraphic location and contained burials that did not conform to normative mortuary practices. Specifically, Context 2 yielded the three earliest, seated burials yet discovered in coastal Oaxaca; these three burials were intrusive to an isolated burn feature. This paper presents a spatially structured intracemetery analysis performed on the cemetery sample, using cervical enamel junction (CEJ) dimensions of the adult dentition. Results indicate that the spatial structure of the cemetery reflected biological distances between individuals from Context 1 and Context 2, suggestive of a general pattern of kin-structured burial. In addition, results indicate that individuals interred in Context 1 shared higher biological affinity than those individuals interred in Context 2. This suggests that the spatial patterning in the cemetery reflected dynamic, extended kinship relationships, or local-nonlocal relationships within the community. These results inform interpretations of collective identity performance and group boundary maintenance within the realm of Early Classic, mortuary practices.

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Social relationships influence gestural communication in wild chimpanzees.

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Several theories exist about how, when, and why language evolved. The gestural hypothesis of language origins theory suggests that the use of gestures played an important role in the evolution of language. Nevertheless, few data exist regarding how our closest living relatives, chimpanzees, use gestures in their natural social and environmental settings. To fill this gap in knowledge, I conducted an 18 month field study investigating gestural communication by wild chimpanzees in an unusually large community at Ngogo, Kibale National Park, Uganda. While carrying out focal animal observations of 29 adult males, 12 adolescent males, 39 adult females, and 16 adolescent females, I collected data concerning who signaled with whom, the frequency of usage, and the responses elicited by gestures. Another goal of this research was to test hypotheses designed to examine the effects of social relationships on gesturing behavior. Results showed that adult males used and responded to gestures with each other more often than they did with adolescents or females. Additional results revealed that adult

males used and responded to gestures frequently with other males with whom they formed strong bonds compared with those individuals with whom they shared weaker bonds. These findings provide some of the very first information about the influence of social relationships on gestural communication by wild chimpanzees and furnish a basis for evaluating the gestural hypothesis of language origins.

This study was funded by the Wenner-Gren Foundation, grant N010731 and L.S.B. Leakey Foundation Grant.

Human fossils from the Paleolithic of Buticha Cave, Ethiopia: results from excavations in 2008 and 2011 with a consideration of the taphonomical context.

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Excavations in 2008 and 2011 at Buticha Cave (Goda Buticha) near Dire Dawa, Ethiopia, exposed a 2.5-meter-deep sequence of cultural strata, divided into two depositional complexes. The upper complex consists of a series of very fine-grained silts, often light in color, and contains pottery, domesticated fauna, and a lithic industry dominated by obsidian tools. The lower complex occupies the bottom 140-160 cm of the sequence, consists of fine brown silt and gravel, contains wild fauna and a LSA or MSA industry dominated by chert artifacts, and has yielded ten hominin specimens. Preliminary calibrated radiocarbon dates bracket nine of the hominin specimens at between 6.3 ka and 35 ka. The last, a fragment of cranial vault, is older than 35 ka. The hominins are represented by five permanent teeth or tooth fragments, two small fragments of cranial vault, a proximal pollical phalanx, a proximal pedal phalanx, and a metacarpal diaphysis. With one exception, the teeth are small in size compared to those of modern South African blacks, of A-Group Nubians, of Nubian samples from the terminal Paleolithic, and from MSA contexts at other sites in Africa, although this last sample does include some notably small individuals. The postcranial specimens are average to small relative to those of recent Africans. The lower complex also contains abundant microfauna and numerous hyena coprolites. Human occupations of Buticha Cave appear to have been ephemeral. The mode and agent of accumulation of the hominin specimens remain to be determined.

Work at Buticha was graciously supported by the National Geographic Society and the Wenner-Gren Foundation.

Male-female oral health differences in early Chinese communities.

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Based on the analysis of nine skeletal collections from the Central Plains of China, this paper examines sex differences in oral health in early farming communities and how these differences changed over time from the Neolithic Yangshao to the Dynastic Period. In virtually all of the skeletal series examined, we found statistically significant male-female differences in caries frequency, antemortem tooth loss, and calculus accretion, as well as in the rate of occlusal tooth wear. Whereas frequencies of carious lesions and antemortem tooth loss were higher among females, other indicators of oral pathology were expressed more strongly in males. In dental sets from Middle and Late Yangshao, the differences in wear patterns between males and females suggest gender related differences in parafunctional tasks performed with the aid of the teeth, probably contributing to sex differences in other oral health parameters. Oral health differences between the sexes during the late Dynastic period seem to have stemmed from a somewhat different set of factors. Female sub-samples of skeletal collections from the dynastic Eastern Zhou period specifically evidenced a substantial increase in the frequency of root caries. This increase was especially marked in a collection from the elite Xiyasi cemetery, suggesting that extrinsic factors affecting the oral health of females changed considerably over time, particularly among wealthier Chinese groups.

This project was supported by PSC-CUNY Research Award #63645-0041.

Status, health, and lifestyle in Iron Age Britain: a bioarchaeological study of elites and non-elites from East Yorkshire.

JOSHUA J. PECK. Central Identification Laboratory, JPAC.

The development of socially-ranked societies has been associated with disparities in human health in a variety of settings, both contemporary and archaeologically. The unique context of the Arras Culture of East Yorkshire provides an excellent opportunity to explore how health and lifestyle may have varied in relation to social factors in Iron Age Britain. Specifically, this research tests the hypothesis that the archaeologically-defined subgroups reflect a socially-ranked society in which the elite and non-elite groups (1) were differentially buffered against physiological stress and infectious disease; (2) consumed dissimilar foods; and (3) were exposed to different patterns of physical activity.

Bioarchaeological data were collected from two middle Iron Age (450-120 BC) cemeteries from the East Yorkshire region of Britain (n=220). Social status was inferred from orientational cosmology, animal symbolism, and grave goods provision. Results indicate a

significant difference in hypoplastic lesions ($p \leq 0.05$), with a higher frequency observed in non-elite individuals, whereas the prevalence of cribra orbitalia ($p=0.81$) and periostitis ($p=0.57$) do not differ between the groups. The similar degree of dental wear ($p \geq 0.05$) and frequency of carious lesions ($p=0.22$) suggest a common dietary pattern, despite a significantly higher prevalence of antemortem tooth loss among the elite ($p \leq 0.01$). A generally higher frequency of vertebral osteoarthritis ($p \leq 0.08$) and trauma ($p \leq 0.08$) among the non-elite is suggestive of exposure to a different pattern of physical activity. These findings partially support the hypothesis that differences in health and lifestyle exist between the archaeologically-defined elite and non-elite groups in Iron Age East Yorkshire.

Aye-aye demography and conservation genomics.

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Compared to other lemurs, aye-ayes have a relatively slow life history, including late weaning and a protracted learning period. While aye-ayes have the largest species range of any extant lemur, their population densities are likely very low. They are primarily solitary foragers with impressively extensive home ranges. Considered in the context of Madagascar's continued forest degradation and fragmentation, such a demographic profile could have severe implications for the long-term survival of this species.

To test demographic and evolutionary hypotheses and generate data for conservation planning, we sequenced the genomes of 15 wild or wild-born aye-aye individuals, 5 from each of three different regions of Madagascar (Northwest [e.g., Anjiamangirana], Northeast [e.g., Mananara-Nord], and extreme North [e.g., Daraina]).

Analysis of this dataset is ongoing, but early findings include that aye-ayes have the lowest level of nuclear genome genetic diversity of any primate yet studied, consistent with our knowledge of their low population densities. In addition, the branch length of the aye-aye lineage, after divergence from other lemurs, is relatively short compared to other primates, surprisingly even 10% shorter than that of the human lineage, otherwise known for a slow molecular clock. This result may be explained, in part, by the slow aye-aye life history.

On the whole, our results suggest that aye-ayes may be at higher risk of extinction than previously thought. Additional demographic study and monitoring are needed urgently.

Anthropoids take smaller bites than strepsirrhines.

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Maximum Ingested Bite Size (Vb) is the volume of the largest bite of food an animal ingests whole. Our ongoing studies have demonstrated that Vb scales isometrically with body mass in a broad sample of strepsirrhines. To begin to test whether this trend pertains to all primates, we collected Vb on three anthropoid species at the Philadelphia Zoo (*Hylobates lar*, *Trachypithecus obscurus*, and *Saimiri sciureus*). Foods from the captive diet were selected for their range of material properties and all could be cut into relatively homogeneous cubes. Material properties data were collected on all foods for comparison with our previous work. We hypothesized that although small anthropoids might have similar Vb to small strepsirrhines, the largest anthropoids would have relatively small Vb compared to the largest strepsirrhines. The competing hypothesis, isometry of Vb, implies unrealistically large foods for the largest living primates. Despite the small species sample for anthropoids, we found clear separation between the strepsirrhine and anthropoid data. All three species of anthropoids had small Vb for their body size, especially the large-bodied species. This might be due to a lack of very large, three-dimensional foods in primate environments, thus reducing the advantage of gape adaptations at larger body sizes. Currently we are gathering data on several more species of captive anthropoids to test the universality of this trend.

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Working activities or workload? Categorization of occupation in identified skeletal series for the analysis of activity-related osseous changes.

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One aspect that contributes to clarify the association between activity-related osseous changes (AROC) and activity is the use of Identified Skeletal Collections for which the individual's occupation is known. Different studies have shown both positive and negative associations. These dissonances reflect not only the biological factors – osseous changes, chosen for analysis –, but also the methods considered in their interpretation and the manner in which occupations were grouped. Furthermore, there is no consensus regarding the criteria of classification in this area. The need to standardize the concept of occupation in its multiple expressions is currently addressed by a working group created after the workshop “*Musculoskeletal Stress Markers (MSM): limitations and achievements in the reconstruction of past activity patterns*”

(Coimbra University 2009). The following information was collected from publications dedicated to AROC for the most important European Collections (i.e., Portugal, UK, Italy, Switzerland): type and number of category, assessment criteria for category and actual attribution of occupations to category. A large cross-table was created including, for each individual the possible classifications, from the most general group considering both socio-cultural and biological criteria (e.g., manual vs. non-manual), to the more specific (a single profession). Since the information available for sexes is very unequal, this parameter was established separately. The cross-table revealed two advantages: it highlights the difficulties found by researchers, clarifying agreements and disagreements, and allows further comparisons between collections from different periods and areas. It is a useful tool for the standardization of occupation categories for future studies.

Correlates of post-conflict affiliation in captive bonobos.

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All social animals face intra-group competition and species are expected to have evolved ways of managing relationships disrupted by these conflicts. Reconciliation and consolation are two of these mechanisms, well studied in chimpanzees and cercopithecines. By contrast, we know little about reconciliation and consolation in bonobos. The Valuable Relationships hypothesis argues that post-conflict behavior (PCB) is influenced by opponents' relationship quality but this is likely not the only relevant variable. Other factors that might play a role in chimpanzee PCB include the costs and benefits related to the intensity of the conflict and the nature of the context (e.g., food, social). Bonobos differ from chimpanzees in the nature of dominance and general aggressiveness. It is expected that bonobo PCB will differ from chimpanzee PCB along these vectors. I predict that reconciliation will be more common after social conflicts (food conflicts may not be costly because of reduced feeding competition) and that intensity will not influence PCB (costs of approaching opponent are not as high in bonobos). The data are observations of 10 captive bonobos at the San Diego Zoo August 2009-March 2010. Conflict data include all occurrences using the post-conflict/matched control method. The analysis examines the relationship between PCB and the conflict variables in 203 conflicts. Analyses were carried out using chi-square and showed no relationship between intensity ($p=.6771$) or context ($p=.4554$) and reconciliation or between intensity ($p=.8311$) or context ($p=.8425$) and consolation. These results suggest intensity and context are not correlated with PCB in this colony of bonobos.

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Human dietary and mobility patterns of a prehistoric population from Sigatoka, Fiji: a reconstruction using stable isotope analysis.

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This paper will explore dietary change and human movement/migration patterns of prehistoric humans interred at the site of Sigatoka, Viti Levu, Fiji through the isotope analysis of human and faunal skeletal material. Our dataset includes human tooth enamel and bone collagen samples of 52 individuals interred at the western and eastern burial groups at Sigatoka, which span four discrete periods of occupation, as well as a series of faunal remains excavated from the site. The aim of this study was to investigate (1) the proportion of marine versus terrestrial protein fraction of the diet through an analysis of stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) values of human bone collagen; (2) the fraction of local versus foreign individuals at the site through an analysis of strontium ($^{87}Sr/^{86}Sr$) values in human tooth enamel; and (3) differences in diet in relation to sex, age, or place of birth through a comparison of isotopic values with previous osteological and mortuary analyses of the burials at Sigatoka. The results of our analyses suggest a diet consisting of mixed marine/terrestrial resources, and while the majority of individuals appear to be local, eight individuals produced non-local strontium signatures relative to local bioavailable strontium values. Although no clear patterns of diet or mobility in relation to age, sex, or occupation period were revealed, our results imply that both marine and terrestrial resources played an important part in the subsistence strategies of prehistoric Fijians, and that some inter or intra-island migration was occurring.

This study was funded by the Department of Anthropology at the University of British Columbia, NSERC, and the Max Planck Society.

Differential diagnosis of severe dental hypoplastic defects in two juveniles from the Pre-Classic site of El Carrizal, Oaxaca, Mexico.

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Presented is the differential diagnosis of severe hypoplastic defects observed in the dental remains of two juvenile individuals recovered from the site of El Carrizal. El Carrizal is a late Pre-Classic period site (~400 BC to 200 AD) located in the Istmo Sur region of the state of Oaxaca, Mexico. Both individuals were found buried in an extended position with various grave offerings, in common with other juveniles of the same age category at the site. Bone preservation at El Carrizal was generally poor, with dental remains the best preserved tissues - a pattern consistent with the two individuals discussed here. The first individual, approximately 5 years of age at the time of death, has severe enamel hypoplasias on several permanent teeth, including incisors, canines and first molars. The canine cusps are reduced in size, while the hypoplastic defects on the upper

central incisors appear as broad bands, particularly on the labial side. A second individual, approximately 8 years of age at the time of death, has a severe enamel hypoplasia occurring at the base of cusps of both permanent maxillary first molars. Diagnoses from nutritional stress to the potential for congenital syphilis will be considered.

A comparative study of treponemal disease in the tibiae of two south Florida archaeological populations: Fort Center (8GL12) and Highland Beach (8PB11).

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Research into bioarchaeology and paleopathology allows for inference testing pertaining to population health and the relationship between disease and group status. The purpose of this study was an assessment and comparison of pathological tibiae from two Woodland populations from south Florida: Fort Center (8GL12) and Highland Beach (8PB11). These skeletal samples are from an inland site and a coastal site, respectively, and appear to represent two different social statuses, allowing for a comparative test of disease prevalence. For this study, we measured the frequency of treponemal disease using macroscopic observations of presence, absence, and the severity of pathological expression, including periosteal lesions, osteomyelitis, and bowing in dry tibiae. Importantly, treponemal disease is easily recognizable on the tibia, allowing for such comparative analysis of differential health patterns between samples of different social status.

The hypothesis for this research posited that there is an association and dependence between group status, group location, and incidence of infection, in this case, treponemal disease. The results provide support for this hypothesis, demonstrating that a coastal and relatively lower status sample had a higher prevalence of treponemal infection than an inland and higher status sample. In sum, we found a disease incidence frequency of 0.62 in the Highland Beach sample, compared to 0.15 in the Fort Center sample.

Discrete dental traits in chimpanzees.

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Descriptions of discrete dental traits form a large part of the differential diagnosis of early hominin taxa. In contrast, the patterns of variance and covariance in dental trait expression are poorly documented in close evolutionary relatives, the extant apes. The aim of this study is to document the nature and patterns of discrete dental trait expression in chimpanzees, and test the hypothesis that chimpanzee species and subspecies can be differentiated by dental traits.

Dentitions of 341 chimpanzees were sorted into subspecies (*P. t. verus*, n=64; *P. t.*

elliotti, n=9; *P. t. troglodytes*, n=143; *P. t. schweinfurthii*, n=79) and species (*P. paniscus*, n=46). Frequency counts were used to document dental trait expression. Chi-square statistics indicate that *P. paniscus* and *P. troglodytes* differ significantly in the frequency of occurrence of the median lingual pillar and mesial fovea on incisors, accessory tubercles on upper third premolar and tuberculum sextum on lower second and third molars. The subspecies of *P. troglodytes* can be differentiated by the frequency of the cingulum on premolars and trigonid crest on molars. Significant differences separate chimpanzee species in mean measure of distance analyses, *P. t. verus* is highly divergent from *P. t. troglodytes* and *P. t. schweinfurthii*, but distances separating *P. t. elliotti* are not statistically significant. This study furthers our understanding of the systematics of our closest evolutionary relative, while providing a framework for interpreting variability in dental traits in early hominins.

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Neolithic population movement in Central Anatolia.

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The Neolithic period of Central Anatolia in Turkey is broadly recognized for its position in the study of early farming societies. At around 7500 BC settlement patterns in Central Anatolia shifted to the west with the abandonment and creation of several sites. Notably, Aşıklı Höyük and Musular were left and the site of Çatalhöyük emerged. It has been hypothesized that this time represents a new configuration of regional population dispersal and that sites may have been aggregating, and Çatalhöyük may represent a nucleation of smaller sites. To test this hypothesis a biological distance analysis was conducted comparing dental data from Aşıklı Höyük, Musular, and Çatalhöyük against an outgroup, a sample of late skeletons also recovered from Çatalhöyük (AD 310 – 1650).

Various multivariate statistical treatments of dental metrics and morphology indicate that all three Neolithic samples are quite similar. These findings seem to confirm the hypothesis that Çatalhöyük could be comprised of other smaller sites and that perhaps as a reliance on agriculture increased so did the need for agglomerated communities. Data also show the Neolithic samples clustering with the late sample. It has been suggested that colonizing farmers of mainland Europe were likely descendent from Central Anatolian populations (Pinhasi and Plucienik 2004), which may explain these results. Neolithic populations of Central Anatolia may be ancestral to several later populations of Europe and the Near East. These results contribute to studies on Central Anatolia population movement as well as the movement of these populations beyond these borders.

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Turkey (Pilloud), and National Geographic Society (Larsen).

Locomotor inferences in *Hispanopithecus laietanus* on the basis of its femoral neck cortical thickness.

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The cortical thickness of the femoral neck has been traditionally related to positional behaviors, since bone tissues are sensitive to mechanical stresses. Previous works have been mostly focused on distinguishing bipeds from other locomotor groups among primates. However, several authors have proposed that differences among other types of locomotion could be also tested. Here we analyze the correlation between the superior and inferior cortex of the femoral neck amongst extant primates (including prosimians, monkeys, apes and humans) in relation to locomotion. The Late Miocene (MN 10) hominoid *Hispanopithecus laietanus* from Can Llobateres (NE Spain) is also included in order to make locomotor inferences for this taxon. The right femur of this species was scanned using computed tomography and the cortical thickness of the femoral neck was quantified taking lineal measurements of the superior and inferior cortices. Morphometric comparisons reveal that suspensory apes display a more homogeneous distribution of cortical bone than other primates (bipeds, quadrupeds and vertical-clingers-and-leapers), which show a superior cortex thinner than the inferior one. *Hispanopithecus laietanus* presents a 1:1 proportion of its cortical thickness, i.e., the thickness of the cortex is virtually the same both superiorly and inferiorly, as in extant apes. Hence, in agreement with previous finds, the locomotor repertoire of *Hispanopithecus* is inferred to have included a significant suspensory component.

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A lethal case of malignant lymphoma in a wild squirrel monkey (*Saimiri boliviensis*) in the Peruvian Amazon.

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Literature on spontaneous lymphomas in wild New World primates is almost nonexistent and few cases have been reported in *Saimiri* (Anzil et al. 1977; McClure 1973). *Herpesvirus saimiri* is generally believed to result in asymptomatic infection in the natural host. However, inoculation into susceptible hosts results in rapid development of acute T-cell lymphoma (Meléndez et al. 1969). We report a case of naturally occurring lymphomas in a wild squirrel monkey (*Saimiri boliviensis*) at Centro para Investigación y Capacitación Río Los Amigos in southeastern Perú. During a focal follow of saki monkeys (*Pithecia irrorata*) in June 2008, we encountered a deceased adult female squirrel monkey. External examination showed the monkey was dehydrated and unusually underweight while manual examination showed no broken or fractured bones. The monkey was transported to the station laboratory for a necropsy, which revealed blood clots under the skin, muscles, kidneys, mesentery, skull, and stomach, and duodenal hemorrhage and orange fatty deposits throughout the body. A histopathologic analysis of tissues revealed a diagnosis of lymphoma as the *causa mortis*, with diffuse metastatic infiltration of atypical lymphoblasts on the myocardium, salivary gland, and other organs. While we can only speculate on the cause of the lymphoma, some evidence suggests that under appropriate conditions *Herpesvirus saimiri* may induce lymphomas in the natural host species (Anzil et al. 1977). These necropsy findings are consistent with those of other primate species infected with *H. saimiri* and comparative analyses may contribute new understandings on the origin and pathogenicity of New World herpesviruses.

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Estimating femoral head size in fragmentary fossils using 3-D surface scans.

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Femoral head size is commonly used to estimate fossil body mass. Unfortunately, many femoral heads are damaged, precluding an accurate estimate of size. 3-D computer models offer the potential to estimate femoral head size in fragmentary fossils by fitting a sphere to a digital 3-D model of the preserved surface, and measuring the sphere diameter. Here we evaluate the accuracy of this method using data on extant apes and humans.

3-D surface scans for 123 specimens of *Gorilla*, *Pan*, *Pongo*, *Hyllobates*, and *Homo* were gathered using a Konica Minolta Vivid 9i laser scanner, and analyzed using Polyworks software.

Femoral head diameters of the scans were measured mimicking standard caliper measurements. To mimic fragmentary remains, femoral heads were divided into a series of 16 patches defined by a series of planes. Spheres were fit using whole, half, quarter, eighth and sixteenth sections of the head, with patches selected at random for repeated estimates for each specimen. Spheres were also fit using randomly selected pairs of patches.

Error rate for the smallest patches was 1.21%, and declined to less than 1% for whole surfaces. Spheres fit using pairs of patches also yielded lower error rates. Estimated femoral head diameters closely matched linear distances, but showed some bias, meaning that estimates of femoral head from spheres either should be corrected for bias empirically, or only compared to estimates based on fitted spheres. The method was illustrated using a series of South African hominins, including estimates for 5 fragmentary femoral heads.

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The shape of the spinal canal and Schmorl's Nodes: two-dimensional shape analysis of lower thoracic vertebrae.

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Two-dimensional statistical shape analysis was performed on digital images of the lower thoracic spine (T10-T12) of adult skeletons from the medieval collections of Fishergate House, St. Mary Graces, and East Smithfield Black Death cemeteries, and the post-medieval Chelsea Old Church cemetery. The aim of the study was to identify possible vertebral shape correlations with Schmorl's nodes. Schmorl's nodes are the result of a herniation of the nucleus pulposus into the adjacent vertebral body and are commonly identified in both clinical and archaeological situations. The lesions have been scored on a basis of severity and the location of the lesion was recorded. The size of the spinal canal has been associated with lower back pain, non-specific stress during growth, and age-related changes; the results of the current study indicate that the shape of the canal may be related to herniation of the intervertebral disc. Cross-validated DFA found an accuracy of 89% of identifying vertebrae with severe Schmorl's nodes from healthy based on the shape of the spinal canal. The results suggest that the shape difference may cause or result in disc herniation, and possibly represent a shape which predisposes an individual to the condition.

Integration and hominoid sexual dimorphism.

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Cranial integration studies in hominoids have focused on either one sex, or in removing aspects of size in order to combine sexes. However, these approaches tend to discount or

deemphasize the role size and sexual dimorphism may have played in cranial evolution. To date, the hypothesis that a sexually dimorphic species displays alternate integration patterns has not been tested. If sexual dimorphism does not affect integration patterns, then mixed-sex samples could be used; this would greatly increase the likelihood of investigating integration in the fossil record, through increased sample-size. 14 cranial measurements were taken on 59 adult male and 53 adult female gorillas, encompassing an equal distribution of neurocranial and facial measurements and in all three dimensions, so as to not bias the results in any one anatomical unit or plane. Integration was quantified in these samples using conditional independence modeling. Results of these analyses indicate that male and female gorillas are characterized by overall different patterns of cranial integration. Both sexes, however, do share the condition of integration within the cranial vault. This indicates that the current strategy of separating out males and females in integration studies, or removing the effects of size and relying on shape only, is the most effective choice; mixed-sex samples of highly sexually dimorphic species are likely to give a skewed result that does not reflect the actual patterns of integration seen in either sex, and as such, would not prove useful in studying patterns of integration.

Trade-offs in relative limb length among Andean children: evidence for extending the thrifty phenotype hypothesis to limb growth.

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The thrifty phenotype hypothesis has had a major influence on research into growth trade-offs under conditions of environmental stress. While brain-sparing growth is often referenced, the existence of growth trade-offs influencing relative trunk and limb proportions has not been explicitly considered. Given documented associations between relative leg length, childhood environment and adult disease risk, elucidating how and when body proportions are determined is important for understanding these associations and the process of adaptation to environmental challenges during growth.

We explored relative limb length, trunk length, head circumference and limb segment lengths (upper arm, thigh, ulna, tibia, hand and foot) in a cross-sectional sample (n=447) of highland and lowland Peruvian children aged 0.5-14.5 years. Highland children experience greater environmental stress than lowland children. Population differences in relative limb and trunk proportions exist from 0.5 years of age. Highland children have significantly shorter limbs relative to trunk length than lowland children. Within limbs, distal limb long bones (ulna and tibia) show greater reduction in relative

length among highland children than proximal long bones or the hand and foot. Head circumference shows the smallest population differences.

The results suggest that the brain and major vital organs of the trunk are relatively protected from stress-related growth restriction at the expense of limb (and particularly distal long bone) length. Hand and foot length are relatively protected compared with the rest of the limb, perhaps for functional reasons. These results support the extension of the thrifty phenotype hypothesis to patterns of limb growth in humans.

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Virtual reconstruction of the Lake Mungo 3 skull.

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Lake Mungo 3 is one of the earliest human skeletons in Australia. While this individual was discovered relatively intact and was recovered during a controlled excavation, the remains are fragmentary. Specifically, the skull, which appears to be fairly intact in published photographs of the *in situ* burial, is incomplete and suffers from relatively poor preservation of the face. Here we present the first virtual reconstruction of the Lake Mungo 3 skull, which was derived from high resolution computed tomography scans of the preserved craniomandibular remains. The morphology of the reconstructed Lake Mungo 3 skull is similar to the morphology of the Lake Mungo 1 cranium. Lake Mungo 3 is compared to a worldwide sample of modern human skulls, and the observations from its new reconstruction have implications for the initial peopling of Australia and the origins and evolution of modern humans in the region.

Relating foraging ecology to locomotor economy and limb length in living apes and fossil hominins.

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How are hind limb length and locomotor economy related to ranging ecology in hominins and other mammals? It is often proposed that increased ranging leads to selection for improved economy and longer limbs, yet there is little evidence supporting these links among extant mammals. Here, I model the selection pressures acting on limb length and locomotor economy in terrestrial animals, using net energy intake during foraging as a proximate measure of fitness. This simple model indicates that

selection for improved economy and increased limb length is highly dependent on foraging efficiency. For species that obtain ten or more calories of food energy for every calorie spent foraging, the selection pressure for improved economy (i.e., lower foraging costs) is very low. Examining daily ranging distances and locomotor costs among 166 extant species suggests that nearly all terrestrial animals, including the great apes, obtain sufficiently high foraging efficiencies that selection for improved locomotor economy is minimal. However, the model suggests that, as early hominins transitioned to habitats or diets with lower foraging return rates, selection for improved economy would have increased dramatically. This may help explain the persistence of poor locomotor economy in apes and the evolution of anatomical features that improve walking economy in australopithecines and later hominins, including modern humans.

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Craniofacial variation among West African populations.

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Previous research into human variation has shown that there is unequivocally more variation within continental groupings rather than among them (Madrigal and Barbujani 2007). However, genetically controlled variation does exist among groups as a function of population structure and history. This research tested whether or not samples from the West African populations of Cameroon (n=11), Ghana (n=13) and Nigeria (n=20) can be distinguished through craniofacial morphology. It was hypothesized that craniofacial measures would not significantly differ among the relatively recently defined nationalities.

Craniofacial data were collected on male skeletons at the American Museum of Natural History. Seven linear measurements were selected to represent the craniofacial region. MANOVA and Hotelling's T² tests revealed differences in craniofacial measurements between Nigerians and Ghanians (MANOVA: p=0.019; Hotelling's T²: p=0.019). Discriminant function analysis and Mahalanobis distances supported the finding that the Nigerian and Ghanaian samples are more distant than either is to the Cameroon sample.

While politically constructed boundaries were postulated to be ineffective in distinguishing the groups, these results show that Ghanaian populations differ in craniofacial morphology from their West African neighbors. The results suggest that the distribution of craniofacial variation in West Africa follows an isolation by distance pattern. Further research is necessary to investigate the degree of variance accounted for by genetics and secular change. These results were also discussed within the broader context of other African diaspora populations. Identifying in what capacity and to what degree groups morphologically differ contributes both to practical applications and to theoretical debates on population histories.

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Understanding the transcriptome of craniosynostosis: a step forward.

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Non-syndrome associated premature fusion of one or more cranial sutures, isolated craniosynostosis, has a prevalence of 1 in 2500 births. The molecular mechanisms of patency and fusion have not been fully elucidated. Formation of calvarial bones occurs through intramembranous ossification where mesenchymal cells proliferate and differentiate into osteoblasts at the osteogenic front. The developing osteogenic front is tightly regulated by precisely timed gene expression. With only 1.5% of the genome coding for proteins regulatory non-coding RNAs are significant contributors to variability. The purpose of this research was to measure both mRNA and regulatory miRNA expression in nonsyndromic craniosynostosis (NSC) and identify those differentially expressed to better understand calvarial morphogenesis and suture patency.

RNA was isolated from paired cranial suture fragments of infants undergoing cranial reconstruction for NSC. Expression levels for both mRNA and miRNA expression were measured for 14 samples (7 paired fused/patent) using Illumina's BeadArray platform. Raw data was processed using Illumina's GenomeStudio 2010v.3. Probe set signals were normalized using the Quantile method. Differential expression was measured using Illumina's Custom Model, FlexArray, and GeneSifter. Three different tests were applied: Log2 Fold changes, Bayes T test, and Wilcoxon Rank Sum.

We identified 32 significantly differentially expressed miRNAs and 106 mRNAs in fused compared with patent sutures. Additionally, there was a negative correlation between several miRNAs predicted to target multiple genes that negatively regulate osteogenesis. These data are a step forward towards the understanding of the proximate molecular mechanisms involved in maintaining suture patency and the transcriptome of calvarial sutures.

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Energetics, power laws, and Paleolithic mobility.

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Verpoorte (2006) and colleagues (Macdonald et al. 2009) employ an energetics approach to investigate Neandertal land-use strategies and the Middle Paleolithic archaeological record of Europe. They use estimates of daily energy requirements of both Neandertals and anatomically modern humans to make predictions about aspects of central place foraging-related mobility—average number of residential moves per year, mean length of stay at a base camp, and total distance traveled per year—that are likely to have implications for the formation of the archaeological record. They propose that a higher energetic demand among Neandertals during the Middle Paleolithic may have precluded investment in site infrastructure (dwelling structures, hearths, etc.) at the level characteristic of the Upper Paleolithic. Verpoorte's model is thought provoking and potentially very useful, but it is also underdeveloped. Here, mathematical models and spatially explicit agent-based simulation are used to more comprehensively address the relationship between energetic demand and foraging-related mobility. The proposed effect of a higher energetic demand on the Middle Paleolithic archaeological record is revisited in light of new results. Cases where the assumptions of the model may not apply to the Pleistocene inhabitants of Europe are also discussed.

Macdonald, K., W. Roebroeks, and A. Verpoorte (2009) An Energetics Perspective on the Neandertal Record. In *The Evolution of Hominin Diets: Integrating Approaches to the Study of Paleolithic Subsistence*, edited by J.-J. Hublin and M. P. Richards, pp. 211-220. Springer, Berlin.

Verpoorte, A. (2006) Neandertal energetics and spatial behaviour. *Before Farming* 3:article 2.

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Morphological variation and the role of allometry in the Galagonidae cranium.

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To gain an insight into the selection pressures causing both inter- and intra-specific variation within the Galagonidae cranium a total of 65 3D landmarks were collected from 740 crania, belonging to 8 species, across 3 genera, using a Microscribe X digitiser. In order to establish the extent to which shape variation is the result of allometry (shape constrained by size) the data were subjected to Generalised Procrustes and Principal Components (PC) analyses. Phylogenetic Generalised Least Square (PGLS) regressions were then conducted in R (version 2.13.1) between species average PC scores and centroid sizes. PGLS controls for phylogenetic non-independence and in this instance a composite phylogenetic tree, generated using the 10K trees website (version 3), was used. The full landmark composition showed significant negative allometry for PC1, with allometric scaling explaining 22.8% of the total residual variance between species, after isometric scaling. The shape change ascribed to PC1 represents a dorso-ventral flattening of the

skull, in both the face and the calvarium, as centroid size increases. Significant negative allometry was also found when functional/developmental modules of the skull, namely the face, basicranium, vault and zygomatic-ptyergoid, were examined separately. The remaining shape variation in the Galagonidae cranium not accounted for by size or phylogenetic effects are discussed in the context of environmental and geographical variation. The Galagonidae represent an ideal family in which to study the interaction between morphology, phylogeny, size and environment, ranging, as they do, across almost all of sub-Saharan Africa, covering an extensive range of habitats and size.

Shape analysis of the proximal MT 4 and MT 5 articular surfaces.

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Proximal MT 4 and MT 5 articular surface shapes were analyzed using geometric morphometrics to test the hypotheses that the human articular surfaces are quantitatively different from those of apes, and that there is no difference in articular surface shape between shod and unshod humans. Shod and unshod humans are compared to *Pan*, *Gorilla*, and *Hylobates*. Shod and unshod humans do not have significantly different surface shapes for MT 4 and MT 5, but both are different from the MT 4 shape of all ape groups. The MT 4 analysis shows a highly convex surface in apes, with the surface of *Hylobates* extending further to the dorsal aspect of this metatarsal. This suggests *Hylobates* has a greater range of motion at the midfoot break compared to African apes. *Gorilla* and *Pan* do not differ significantly from one another in MT 4 surface shape, whereas *Hylobates* is different from the African apes. The MT 4 fossil specimens OH 8 and Stw 628 show greater morphological affiliation with humans. The MT 5 analysis shows that *Pan* and *Hylobates* have a medio-laterally extended and concave articular surface that is convex in the dorso-plantar plane. The human groups are narrower and flatter in the medio-lateral plane, with a smaller degree of dorso-plantar convexity. There is considerable overlap in shape patterns between groups in the MT 5 analysis. The MT 5 fossil specimens AL 333-13, AL 333-78, OH 8, and Stw 114/115 show closer affiliation to humans and *Gorilla*.

Trabecular bone architecture in supraorbital region of *Homo*, *Pan*, *Gorilla*, *Papio*, and *Cebus*.

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Post cranial trabecular bone architecture has been used as a tool to assess primate life history in living and extinct species. Trabecular architecture in cranial regions differs from that seen in postcranial regions in bone volume fraction (BVF) and structure model index (SMI)

and it is unknown to what degree it is reflective of life history patterns, such as feeding strategy.

In this study, uCT was used to determine the BVF and anisotropy (DA) of the trabecular bone in 5 supraorbital regions (from the lateral orbit to the sinus) of 8 *Homo*, 4 *Pan*, 5 *Cebus*, 4 *Papio*, and 1 *Gorilla*. Kruskal Wallis tests determined significant differences by species across locations in trabecular bone strength predictive variables, such as BVF and DA ($p=0.01$ and $p=0.06$, respectively). In all species, except humans, BVF and DA tend to decrease moving from lateral to medial, with the highest BVF values in the lateral most region of the browridge. Overall, BVF values are greater in the gorilla specimen and less in the human group. BVF and DA decline sharply from lateral to medial in four of the five *Cebus* as the frontal sinus cavity occupies the region more laterally than in other primate species.

The results suggest that trabecular structure within the supraorbital region may be reflective of feeding strategies. Additional study of trabecular bone architecture within craniofacial bone is needed to see if it can be used as a tool to assess masticatory patterns among living and extinct groups of primates.

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Relationships of gender and socioeconomic status with dental caries and early childhood malnutrition in Haitian children.

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The purpose of this report is to present findings from the 1999 Basic Oral Health Survey (BOHS) of Haiti and a 2005 investigation of the association between early childhood protein-energy malnutrition (ECEM) and oral conditions. The focus will be on the association of gender and socioeconomic status (SES) with dental caries and ECEM.

The BOHS used W.H.O. pathfinder methodology for a national survey of caries in 5-7, 12, and 15-year olds. The ECEM retrospective cohort study utilized measurements of weight-for-age of 1,058 rural Haitian children from birth to five years old in 1988-1996 with oral examinations conducted in 2005. Dental caries index (DMFT) was regressed on gender, age, SES and ECEM status. A socioeconomic scale composed of 6 factors developed for rural Haiti categorized children as poor, poorer, and poorest.

Permanent dentition caries (DMFT) was associated inversely with ECEM, positively with SES and had no statistical association with gender. SES correlated with ECEM levels.

The findings raise questions regarding the conventional wisdom of caries and its relationships with gender, SES and malnutrition. Healthy adolescents had higher DMFT scores. Gender may not be associated with caries or ECEM in some societies, while very minor differences in "capital" acquisition is an important factor for caries and ECEM, even in a relatively homogeneously impoverished, rural environment as found in Haiti. The finding of health effects defined by minor differences in a

SES measure should be of interest to anthropology, while the question of an ECPM and permanent dentition caries association remains unanswered.

Very minor differences in "capital" acquisition in impoverished rural Haiti is a risk indicator of dental caries and has an apparent protective effect against early childhood malnutrition. Gender was found to not be associated with adolescent caries or ECPM.

Functionally-related morphometric maps of femoral cortical bone topographic variation: *Homo* vs. *Pan*.

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Within the limits imposed by a variety of developmental and rheological constraints, bone tissues respond and adapt to the external and internal loads by partial alteration of their shape, mass, microstructure. As bone distribution/organization locally reflects the nature, direction, frequency, and magnitude of such loads, measures of topographic variation of the cortical shell can be used as a proxy for assessing the taxon-specific dynamic relationships individual-biomechanical environment.

Based on the assumption that variation of local morphometric properties along the femoral diaphysis relates to functional levels and patterns of habitual physical activity, primarily to locomotion, we characterized the human and chimpanzee conditions through virtual rendering of their respective endostructural signatures.

By using the CT-based record from 20 modern human and 12 chimpanzee adult femurs, we imaged the site-specific changes in cortical bone through standardized morphometric maps generated by virtually unzipping and vertically unrolling each shaft along the middle of its anterior aspect within the portion 20-80% of the biomechanical length. The analyses were coupled with the comparative assessment of cross-sectional geometric properties.

Compared to *Pan*, the human femoral diaphysis is more robust (CA and PCA) and presents a higher Ix/Iy ratio in the midshaft region. In both taxa, thickness distribution is not uniform, but widely and unequally changes vertically along the diaphysis and horizontally according to different projections. In chimpanzee, a strong medial and lateral reinforcement is found in the proximal part of the shaft, while in humans it occurs posteriorly. The proximal shaft portion (60-80%) is the most discriminant one.

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Coping strategies of a disabled female *Propithecus verreauxi* at the Beza Mahafaly Special Reserve, Madagascar.

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Recent studies have demonstrated behavioral plasticity among disabled primates. Gorillas and chimpanzees, for example, adjust food processing techniques in order to minimize loss of efficiency caused by hand disabilities. Among Strepsirrhines, ring-tailed lemurs (*Lemur catta*) who have lost the majority of their teeth adapt by changing foraging strategies. For this research, I compared the activity budgets and postures of a disabled female sifaka (*P. verreauxi*) with that of uninjured individuals in an effort to understand the coping mechanisms sifaka use to adapt to injury.

In July of 2011, at the Beza Mahafaly Special Reserve, Madagascar, I recorded 38 hours of continuous focal animal observations for the activity budgets of two female and one adult male *P. verreauxi*, between 9AM and 12PM. One of the adult females appeared to have fractured her radius and ulna; she could not use her left hand. I recorded video and notes pertaining to the postures of each of the three lemurs.

Paired-samples t-tests showed that the injured female did not spend less time feeding than the uninjured pregnant female ($p = 0.19$), nor were there differences observed between the latter and the male ($p = 0.058$), but that the injured female did spend less time feeding than did the male ($p = 0.048$). The injured female spent 3.84% of feeding time suspended, while the uninjured female and male spent 19.46% and 20.41% of feeding time, respectively, in a suspensory position. These results suggest that disability may constrain feeding time among sifaka.

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Bioarchaeological analysis and repatriation of the massacred Yaqui men, women and children studied by Hrdlička.

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The field of bioarchaeology lends itself to a holistic approach to the interpretation and analysis of violence. Bioarchaeologists have been able to broaden the theoretical paradigms surrounding interpersonal and intentional forms of violence. This project examines skeletal evidence of stress in Yaqui individuals ($n = 13$) collected in 1902 by Ales Hrdlička in Sonora, Mexico, after a massacre of 124 men, women, and children by Mexican troops. Remains were examined for evidence of physiological stress, including cribra orbitalia, porotic hyperostosis, dental enamel hypoplasia and skeletal lesions. Data were also collected on healed or healing trauma. Results indicate pervasive stress among the Yaqui, with 77% ($n = 10$) displaying evidence of physiological stress and 31% ($n = 4$) displaying evidence of healed or healing trauma.

The remains were examined to determine the range and extent of perimortem trauma, antemortem trauma, pathologies and age and sex. Results indicate that several individuals died from blunt force trauma or gunshot to the head: two display evidence of being shot at point-blank range and three display evidence of perimortem blunt force trauma. In addition, three individuals exhibit healed or healing fractures, eight exhibit healing lesions from porotic hyperostosis or cribra orbitalia, and eight exhibit linear enamel hypoplasia. This suite of pathologies supports historical accounts detailing the stress the Yaqui experienced due to pervasive oppression by the Mexican government. This research speaks to how the scholarship of engagement through the repatriation process provides for a more inclusive and truly collaborative project that benefits all parties.

The effect of age on gestural communication in captive bonobos.

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Research on the origins of human language and its potential antecedents in primate communication has focused on vocal communication. However, there has been a recent resurgence of interest in the role of gesture, especially in the great apes. This study sought to examine the influence of age on the frequency, type, and context of gestures performed by a captive group of bonobos, *Pan paniscus*. In addition we examined how age influences the frequency of tactile and non-tactile gestures. It was hypothesized that because infants are frequently more physically active than adults, they would have a higher frequency of gesture, and that because a great deal of infants' time is spent in play, most gestures would be performed in that context. The twelve bonobo subjects were housed at the Cincinnati Zoo and Botanical Gardens. Over a nine-week period of study, 2177 gestures were recorded. Twenty-nine distinct gesture types were observed within seven contexts. All occurrence focal (small) group sampling was used to collect data. A Kruskal-Wallis test indicated that infants gesture at significantly higher rates than sub-adults or adults. Finally, the ethogram was divided into tactile and non-tactile gestures. A Chi-square test demonstrated that infants use tactile gestures significantly more than they use non-tactile gestures. This is the first study to focus on the effect of age on gestural communication in *Pan paniscus* and adds to the growing body of research on gestural communication in great apes.

Neurological and signaling pathways are associated with variation in skin color.

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Skin color has long been of interest to anthropologists, but complete understanding of the underlying genetic architecture remains elusive. Continuous variation and complex evolutionary history suggest many genes of small effect contribute to the range of human skin color, but these are difficult to detect by genome-wide association (GWA). Gene set-based analytic (GSA) methods identify gene classes or pathways associated with the phenotype of interest that may contain these genes.

Beyond melanin synthesis, skin pigmentation relies on diverse pathways including cell differentiation, proliferation, and cellular signaling which may contain genetic variation related to skin color. GWA for constitutive pigmentation was performed on 383 Mexican Americans from the San Antonio Family Diabetes Study while controlling for ancestry. The Database for Annotation, Visualization and Integrated Discovery (DAVID) was used to annotate gene ontology, cluster genes based on function, and identify classes of genes more common among the genes of interest than the genome at large.

Markers in the top 5% of the GWA data were significantly ($p < 0.01$) enriched four-fold for genes involved in tyrosine regulation and two-fold for ion/cation channel activity which includes known pigmentation genes like *TYR* and *SLC24A5*. Unexpectedly, we found two-fold enrichment for genes involved in neuronal cell junctions and the MAPK signaling pathway. Although not classic pigmentation pathways, neurons share developmental origins with melanin-containing keratinocytes and MAPK signaling regulates *MITF*, a pivotal transcription factor in melanogenesis. By enabling pattern recognition not evident from single-gene analyses, GSA has identified four pathways for further biochemical and genetic analyses.

What can muscle insertions tell us about activity during life? Functional anatomy and development of the deltoid tuberosity in wild-type mice.

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Muscle attachment sites are often used to reconstruct the lifestyles and activity patterns of past populations, but little is known about how activity patterns influence the development of muscles and the morphology of their bone insertions. The main goal of this project was to explore this relationship by testing how activity influenced the morphological development of the deltoids and pectoralis muscles and the corresponding deltoid tuberosity in wild-type

mice subjected to three experimental activity patterns: sedentary-control, activity-wheel running, and activity-climbing. Each mouse (four- and seven-week-old at the start) received three vital fluorescent bone-labeling dyes (alizarin, DCAF, xylenol) at two-week intervals over an eleven-week period to allow for histological examination and calculation of bone growth rates underlying the deltoid attachment site. After the experiment, the muscles were weighted, fiber and sarcomere lengths were calculated and humeri were cleaned, digitally photographed, and 100-micron thick cross-sections at the deltoid tuberosity were prepared for histological analysis. Analysis of sarcomere length and muscle weight indicate that wheel-running mice had greater overall excursion, especially in the pectoralis muscles, while the climbing mice had greater deltoid muscle stretch advantage compared with the sedentary mice. The rate of bone growth was significantly greater in wheel-running mice than the other groups. However, the climbing mice showed more histologic variation in bone growth remodeling (e.g., evidence of drifting osteons). Results contribute to a better understanding of how muscle and bone interact throughout their development and improve our ability to interpret behavior from human and non-human primate skeletal remains.

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Y chromosome diversity in Inupiat populations of the Alaskan North Slope.

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The Inupiaq-speaking populations of North Alaskan slope, descendants of the Neo-Eskimo Thule peoples who colonized the arctic approximately 1000 years before present, are the focus of ongoing genetic investigations aimed at characterizing their origins and population history. Previous and ongoing mitochondrial DNA analysis of North American Arctic populations, including our investigations of Northern Alaskans, indicates reduced genetic diversity compared to other Native American groups. However, analyzing only the maternally-inherited mitochondrial genome captures only a fraction of total genetic diversity and potentially introduces biases in interpretations of population history. We determined Y-chromosome profiles for a suite of 16 STRs (DYS19, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, DYS385, DYS438, DYS439, DYS437, DYS448, DYS456, DYS458, DYS635, YGATAH4) for 67 consenting males from eight villages throughout the Alaskan North Slope. We compared these to published results from Greenlandic Inuits (Bosch et al. 2003), as well as over 93,000 publicly available haplotypes from

the Y Haplotype Reference Database (<http://www.yhrd.org/>). Of the 67 lineages observed, 9 (13%) were identified as non-Native American but predominantly found in Russia and Eastern Europe. This contrasts with the higher (58%) rates of admixture found in Greenlandic Inuits (Bosch et al. 2003). Seventeen Inuit Y lineages were shared with a recently reported sample of Inuit males from forensic studies (Davis et al. 2011). In contrast to reported maternal lineages, Y chromosome gene diversity among North Slope Inupiaq was high (0.9856 +/- .002). We discuss the implications these results have for our interpretation of Alaskan Arctic genetic history.

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A diachronic comparison of the skeletal fusion rate of the knee joint.

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Several studies have been done making note of the order in which the epiphyses and diaphyses in the knee fuse together in juveniles, usually describing the fusion in stages. Stages of fusion each have characteristics associated with them that describe the changes in different ossification centers; these stages can usually be associated with different age sets, so that when studied, they can help point toward an unknown person. With all of the research conducted on the topic of fusion rates, there is a lack of literature comparing recent correlations between chronological age and rate of fusion with standards that set precedence. The purpose of this study is to investigate the idea that modern populations are advancing through these stages at a faster rate than when compared to populations from the early 20th century (which remain the current set of standards used by forensic anthropologists). Radiographs of 13 males and 9 females, between the ages of 10 and 20, were compared with the skeletal remains of 56 males and 27 females, between the ages of 10 and 21, from the Hamann-Todd Collection at the Cleveland Museum of Natural History. The sexes of each collection were compared with each other and scored using the definitions outlined in O'Conner et al. (2008). While findings of this research suggest a difference in fusion rates through trends seen in both sexes, our tests showed a statistical significance that indicates tibias in male children are fusing at a faster rate than prior records show.

Species-specific distributions of cholinergic innervation in the neocortex of anthropoid primates.

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Cortical cholinergic innervation has been implicated in learning and memory functions. Additionally, variation in the density of cholinergic axons within the neocortex has been associated with inter-individual differences in learning abilities among rodents. Our earlier analyses revealed differences in cholinergic innervation within the frontal cortex among humans, chimpanzees, and macaques. To explore this finding further, the present study represents a large-scale comparative analysis of cholinergic innervation among a wide range of anthropoid primate species, including humans, chimpanzees, gorillas, baboons, moor macaques, pigtailed macaques, capuchins, and squirrel monkeys. Stereological methods were employed to obtain cholinergic axon length density to neuron density ratios (ALV/Nv) in layers III and V/VI of areas 44, 22, 10, and 24. The ratio of varicosity density, an additional measure of innervation, to neuron densities (Vv/Nv) was also quantified in layers III and V/VI of area 24 and area 44. In all layers and areas, Vv/Nv was significantly correlated with ALV/Nv. Results of a mixed-model ANOVA indicated significant differences in the densities and patterns of cholinergic innervation among species that did not follow a phylogenetic pattern. Post hoc analyses demonstrated that differences included significantly divergent patterns and densities of innervation between the two macaque species included in this analysis, but did not reveal a human-specific increase or alteration of cholinergic innervation within the cortical areas examined here. The results of the present comparative analysis, including a large number of primate species, demonstrate that human cognitive abilities are independent of a significant increase in cortical cholinergic innervation.

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Aerobic activity in the Hadza hunter-foragers of Tanzania.

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Recent work suggests that the Hadza (hunter-foragers in Tanzania) expend similar amounts of energy per day compared to urban-living populations, and individuals do not reduce energy expenditures with age. However, it is unclear how variation in activity levels contributes to overall energy use. To investigate daily activity levels, we measured heart rates (HR) continuously in a sample of 39 individuals from two Hadza camps over two field seasons. Measurements were taken over consecutive days (ranging from seven to 14 days) from dawn to dusk. We converted raw HRs into percentages of age-adjusted maximum HR (MHR) using equations from the literature. We calculated the amount of time spent in seven different HR zones each day (from less than 40% MHR to

greater than 90% MHR, increasing in 10 percent increments). Age had a significant effect on time spent in HR zones (MANOVA $p = 0.01$), with older adults spending more time in higher HR zones than younger individuals. Sex had no significant effect on time spent in HR zones ($p = 0.13$). In most individuals (~70%), time spent in the high aerobic zones (>70% MHR) on consecutive days has a negative autocorrelation, indicating most individuals alternate hard and easy days. We explore the implications of this daily energy use strategy and suggest that it is only possible when food sharing among both kin and non-kin allow for sufficient rest following long, aerobically active foraging bouts. We also explore the physiological and behavioral causes of age-related variation in activity measured by HR.

This study was funded by NSF BCS 0850815.

Evaluating adrenocortical activity in free-ranging rhesus macaques using cortisol from hair.

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Most studies of the vertebrate stress response rely on short-term (hours-days) measures of glucocorticoid levels. Yet, these indicators have certain limitations, which may complicate the assessment of chronic activation of the stress response. By contrast, hair cortisol concentrations represent an integrated long-term (weeks-months) measure of the mammalian activation of the hypothalamic-pituitary-adrenal axis. As this analysis is more resistant to short-term environmental perturbations and variation in sampling conditions, it may provide a useful assessment of baseline adrenal function, in conjunction with non-invasive techniques. To determine the time period represented by hair samples, we used previously validated assays to compare cortisol concentrations in hair to glucocorticoid levels in fecal samples in 27 free-ranging adult male rhesus macaques. Hormone values obtained from hair of young and middle-aged males were positively correlated with average fecal glucocorticoid levels over the 4 months preceding hair collection ($r_s = 0.43$, $n = 20$, $p = 0.059$). We then evaluated the relationships between hair cortisol levels and socio-demographic factors. Low hair cortisol concentrations were associated with higher rates of intrasexual grooming, lower rates of directed aggression, older age, and/or higher dominance rank. Males in a large social group had significantly higher long-term cortisol levels than males in a small social group (2-sample t -test: $t = 3.848$, $df = 18$, $p = 0.001$). This first study of hair cortisol levels in free-ranging primates indicates a potential of hair hormone analysis to elucidate long-term physiological patterns in mammalian populations, in which hair shaving and re-shaving are possible. Further work is needed to determine how aging may affect hair growth rate across species.

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Hearing sensitivity and the evolution of acoustic communication in platyrrhine monkeys.

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A prevailing concept in the literature is that body size constrains hearing sensitivity and vocal communication. Among primates, larger species tend to send and receive low-frequency vocal signals, whereas smaller species utilize higher frequencies. In studies of vocal communication, this phenomenon is known as the motivation-structural (MS) rule, can account for the suboptimal acoustic structures many of vocal signals. The New World monkeys represent a model system for testing this scaling concept, yet few data exist on the auditory sensitivities of platyrrhine primates. Here we explore this premise by presenting new data on the auditory sensitivities of nine species: *A. caraya*, *A. clamitans*, *A. palliata*, *Ateles belzebuth marginatus*, *A. geoffroyi*, *Brachyteles arachnoides*, *Callicebus cupreus*, *Cebus apella* and *Lagothrix lagotricha*. We found that the high-frequency hearing limit was negatively related to interaural distance; however, this relationship was influenced by phylogenetic relatedness and did not extend to the frequency of best auditory sensitivity. In addition, several conventional parameters of vocal acoustics (mean values for the vocal repertoire) were unrelated to body mass; for each species, there were vocalizations that corresponded closely with auditory sensitivity (often calls emitted by infants), but the associated motivational states varied. Taken together, these findings challenge the idea that acoustic communication varies primarily as a function of size. Rather, a complex array of phylogenetic, anatomical and ecological factors appears to have exerted a selective pressure on the platyrrhine auditory system.

TMJ osteoarthritis and modernisation: influence of the industrial revolution on disease prevalence.

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The temporomandibular joint (TMJ) is intimately linked to mastication (and as such, diet), with research on animals and modern clinical studies suggesting that temporomandibular joint osteoarthritis (TMJ OA) may be connected to soft dietary composition and associated with reduction in the craniofacial complex. Over the past 100,000 years, the form of the human face has undergone marked changes, from large and robust, to relatively small and gracile. Concordantly, human diet changed profoundly; first in transitioning from hunter-gathering to agriculture, then again in the shift to the post-industrialised diet. This has markedly increased the rate of caries and malocclusions, while the severity of dental wear has notably decreased. The question remains as to whether these dietary shifts, particularly modernisation, have impacted the temporomandibular joint, specifically TMJ OA.

Three assemblages with distinct dietary patterns (a modern documented collection, Medieval and post-Medieval Londoners, and Prehistoric Native Americans) were examined for the severity of tooth wear, presence of TMJ OA, morphology of the TMJ, and cranial metrics. TMJ OA prevalence was as follows: Prehistoric Native Americans 10.6%; Medieval 13.3%; post-Medieval 29.5%; modern documented 30.2%. The results suggest that differing patterns of subsistence can impact the distribution and frequency of TMJ OA, with OA highest in the contemporary assemblages; this is concurrent with a decrease in tooth wear severity and a reduction in mandibular size. The increase in TMJ OA is likely the result of a change in the functional biomechanics of the joint, creating a less stable and more disease-prone environment.

Correlation between elastic modulus and radiographic density in mandibular cortical bone of colobine monkeys.

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The reality of spatial variation in bone elastic modulus compromises homogeneous structural models of bone stiffness used in comparative research. Previous comparative heterogeneous structural models developed by us (*AJPA* 131:243-251 and S42:151) used radiographic density in the form of grayscale as an isometric surrogate for elastic modulus. In this investigation, we evaluate the reliability of this surrogate by examining covariation between

grayscale and elastic modulus in mandibular cortical bone of cercopithecoid monkeys.

Our sample consisted of transverse sections from six adult colobine mandibles (three specimens each of *Colobus polykomos* and *Procolobus badius*) known to differ in diet. We used the combination of micro-computed tomography (micro-CT) and microindentation to generate grayscale-modulus pairs in submillimeter-sided regions of bone. Each specimen was scanned using a micro-CT system with a spatial resolution of 23 micrometers. Groups of four Vickers microindentation tests were performed on prepared transverse sections that corresponded to micro-CT sections. All microindentations (intra- and inter-group) were spaced so as not to influence each other, yet each group resided within a square millimeter. An average microindentation hardness was determined for each group and then converted to an average elastic modulus using established methods. A region of cortical bone circumscribing each group was selected, and an average grayscale was determined using custom MATLAB-based software.

We found a strong power law correlation between grayscale and elastic modulus. This finding legitimizes the use of radiographic grayscale as source data for models that seek to incorporate stiffness variation into measures of bending and torsional rigidity.

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The nutritional contribution of insects in the diets of modern humans: a geometric analysis.

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We review the occurrence of human entomophagy, and use a multi-dimensional technique known as the right-angled mixture triangle to test whether nutritional regularities underpin the diverse roles played by insects in human foodways. Insects have likely featured in the evolution, prehistory and history of the human diet. For contemporary humans, the most notable aspect of their contribution to the diet is its diversity. In some societies entomophagy is regarded with disgust, but this is the exception, with insects being eaten in approximately 80% of modern nations. Among these populations the extent and patterns of entomophagy are diverse. In some cultures insects are eaten only when other sources of animal protein are scarce, whereas in others they are a sought-after resource. Among these, their role ranges from an occasional delicacy to a substantial proportion (> 50%) of animal-derived protein. In many cultures edible insects are opportunistically collected, whereas in others they are semi-farmed or even farmed on a commercial scale. Credible estimates of the number of insect species eaten by contemporary humans range between 1000 and 2000, although most of those eaten in significant quantities belong to one of six orders (Lepidoptera, Coleoptera, Orthoptera, Isoptera, Hymenoptera and Hemiptera). Our analysis shows that compared with insects eaten

by other primates, the composition of those eaten by humans is diverse. We conclude that to understand the nutritional basis for the diversity of entomophagy in humans, more information is needed on the compositions of non-insect components of the diets of the various cultures.

We are grateful for financial support from the National Research Centre for Growth and Development, New Zealand.

Intraspecific variability in tannin contents of tree leaves consumed by colobus monkeys (*Colobus guereza* and *Procolobus rufomitratus*) in Kibale National Park, Uganda.

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Hydrolyzable tannins (HT) and condensed tannins (CT) are high-molecular weight, polyphenolic compounds, and are the most common type of plant secondary metabolites. Studies have indicated they are a plant defense against herbivory because they can be toxic, are bitter tasting, and they bind dietary protein rendering it unavailable for digestion. We know little about how tannins differ intraspecifically within tree leaves in tropical climates. We selected seven tree species commonly consumed by black and white colobus (*Colobus guereza*) and red colobus monkeys (*Procolobus rufomitratus*), and examined them for HT and CT. For each tree species, we analyzed samples of young (YL) and mature leaves (ML) from at least 5 individual trees to assess how tannin levels vary intraspecifically according to crown layer, leaf maturity, and individual. It has been hypothesized that stress from increased light intensity may induce CT production in upper crown leaves, but we did not find this pattern (matched pairs test, $p=0.997$). Although studies have suggested that ML contain more tannins, we found that *Celtis africana* YL contained more CTs than did ML (matched pairs test, $p=0.005$), while in others there were no differences between YL and ML. Intraspecific variability in leaf HT and CT varied widely depending on individual tree sampled. For example, some trees had 10 times the amount of tannin as other individuals sampled in the same week. These results highlight the need for sampling from the same tree where monkeys are feeding and further investigations into the finer levels of primate food selection.

Force of habit: dietary properties, masticatory function, and cranial plasticity.

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Dietary properties have a profound effect on craniofacial development, inducing a cascade of changes at the gross, tissue, cellular, protein and genetic levels. Indeed, diet-related variation in masticatory stresses is thought to result in tissue modeling and remodeling that maintains the structural integrity of the feeding complex. However, our knowledge of the hierarchical network of such plasticity responses is differentially limited to bony elements. Because jaw joints are composite structures comprised of hard and soft tissues, analysis of the nanoscale properties of joint cartilage may provide unique information regarding the mechanobiology of the masticatory system in growing organisms.

We investigated the plasticity of jaw-joint cartilage in three rabbit cohorts obtained as weanlings and raised on different diets until adult. To account for the viscoelastic or time-dependent behavior of biological tissues, maximum load (creep) and maximum displacement (relaxation) tests were performed on the cartilage with a spherical-tip indenter with 20-micron radius. The creep test was performed with a 500 μN maximum load for 30 seconds, while the relaxation test occurred with a 3-micron maximum displacement for 30 seconds. The DMA (Dynamic Mechanical Analysis) test was used to obtain storage modulus and loss modulus.

Results indicate that long-term variation in masticatory forces related to dietary properties is associated with changes in nanoscale cartilage properties, which in turn underlies variation in jaw-joint biomechanics. This engineering approach offers novel insights into the functional bases of anatomical variation in joint formation, with myriad implications for understanding the evolution of the primate skull and feeding apparatus.

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Lemur movement pattern and its implications for seed distribution.

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Many frugivorous primates disperse the seeds of numerous tropical plant species. The foraging movement pattern of such seed-dispersers may influence the distribution of plant populations because it determines the destination of a seed, including its direction and the distance it is carried from its source. However, relatively little is known about the movement patterns of these groups of primates. We examine the movement of a guild of frugivorous Malagasy primates (*Eulemur rubriventer*, *Eulemur rufus* and *Varecia variegata*) and predict its implication in shaping the spatial distribution of seeds. In order to understand the general pattern of their movement, a group of lemurs were continuously followed daily and their location every 15 minutes increment were recorded, for a total of nine groups per species. We combined gut retention time with movement data to predict seed shadows, and created a spatially explicit model of seed dispersal to predict the patterns and densities of dispersed seeds. With a majority of movement of long distance and duration during a day's foraging, these lemur species may create scattered distribution of seeds and carry ingested seeds far from their source, predicting non-leptokurtic seed shadows. Different patterns of movement and range size result in different patterns of seed dispersal and distance from source trees.

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Genomic sovereignty in practice: promise, paradox, peril.

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Following the Human Genome Diversity Project debacle of the 1990s, difficulties implementing the Native American Graves Protection and Repatriation Act (NAGPRA), the Nuu-chah-nulth Tribe case, and the Arizona State University-Havasupai case, scientists, ethicists, and policy makers alike began to recognize that dominant Western technoscientific, legal, and economic values provide a too narrow ground upon which to produce knowledge in ways that is just and beneficial for diverse members of society, including indigenous peoples. To remedy this problem, a number of new initiatives emerged that sought to enable indigenous people to take greater control of the research process. The U.S.

National Institutes of Health (NIH) and the Indian Health Service (IHS) created funding streams available to only native PIs. Researchers began to name tribes and First Nations as "owners" of the intellectual property arising from their research. This paper draws on fieldwork in the U.S. and Canada that explores how these recent experiments in indigenous "empowerment" in research play out in practical terms.

Relative long bone proportions and developmental stress in a modern Thai population.

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Research concerning relative, or scale-free, limb proportions has revealed interesting patterns of variability with regards to environment. However, there have been no direct attempts to correlate variability in limb proportion with unrelated stress indicators. In response, this study examined the relationship between long bone length ratios and linear enamel hypoplasia (LEH) frequency in a modern Thai population.

Proximal/distal limb bone length ratios were calculated for 269 adults (105 female/154 male) and compared against LEH frequency. Analysis using Pearson's correlation indicated significantly shorter relative distal limb lengths in the lower limbs of individuals with high LEH frequencies. This pattern was strongest in females, with statistically significant correlations in the tibia/femur ($p=0.019$) and the fibula/femur ratios ($p=0.007$) when compared with LEH frequencies, especially on the right side. LEH frequencies were also highly correlated with stature among females. In males, only the fibula/femur ratio demonstrated a significant relationship with LEH frequencies ($p=0.008$), and only on the left side of the body. No correlation between stature and LEH frequency was found in males, or between LEH frequency and long bone length proportions in the upper limbs of either sex.

These findings support claims that distal limb growth is more strongly affected by developmental stress than proximal growth. In this study, the upper and lower limbs demonstrate different responses to environmental stress. This disparity, in addition to the strong association of limb bone length ratios and LEH frequency in females, may have significant implications for our understanding of human limb development and catch-up growth.

Integrating ecological proxies to understand the distribution of woody plants in African environments.

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Presentation Withdrawn

Recently, Cerling and colleagues (2011) reinterpreted soil carbon isotopes from East African hominin localities, concluding that woody cover in the earliest hominin habitats was less than previously suggested. They note that from ~3.6 – 3.0 Ma, woody cover increased to 40 – 60%; a value corresponding to fairly closed habitats – unless the woody cover is shrubs. There appears to be a key disjunction between type and amount of woody cover represented by soil isotopes and paleohabitat reconstructions using associated mammalian fauna from some hominin localities.

To explore this disjunct, we analyzed the large mammal communities from 52 modern African sites using correspondence analyses to determine the relationship between community membership and vegetation structure. We included more than 20 modern communities that corresponded to Cerling et al.'s soil isotope collection areas. Sites were coded according to UNESCO habitat designation, and were analyzed using mammalian trophic and substrate adaptations that are known to reflect vegetation structure ranging from forests through grasslands. Results suggest that mammalian community structures do not correspond to woody cover suggested by the soil isotopes, possibly because of the inability of the isotope data to distinguish among trees, bushes or shrubs. Conversely, ecological community structure can predict mean annual precipitation, which is associated with type of vertical vegetation. We conclude that integrating a variety of methods is necessary for paleoenvironment reconstruction and to understand the interrelationship between the primary evidence provided by photosynthetic pathways and secondary evidence derived from mammals that utilized both the plants and their structure.

Acetabulocrystal buttressing in hominins.

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The acetabulocrystal buttress is an indistinct feature in australopiths, but becomes prominent in early and modern *Homo*. It has been suggested that this thickening is due to increased bending moments in the iliac blade from m. gluteus medius acting in abduction; alternately, it may protect against bending stresses due to increased medial curvature of the anterior iliac blade. *Australopithecus sediba* has several pelvic features that suggest a modern alternating pelvic tilt mechanism with increased abduction of the gluteal muscles, including more vertically oriented iliac blades and distinct sigmoid curvature. Therefore, one would expect to find a relatively pronounced iliac pillar in *Au. sediba*.

We examined the differences in the acetabulocrystal buttress between hominin groups, measuring the angle, the distance posteriorly from the anterior superior iliac spine, and the thickness of the buttress. Data were collected from original fossils and casts representing *Australopithecus afarensis*, *Au. africanus*, *Au. robustus*, *Au. sediba*, *Homo erectus*, *H. neanderthalensis*, and early

Pleistocene African *Homo* sp. indet.. Measurements were also taken on a sample of 107 modern human skeletons from the Raymond Dart collection at the University of the Witwatersrand.

We found significant differences in measures between australopiths, early *Homo*, and modern humans; *Au. sediba* was not significantly different from australopiths. Furthermore, a significant difference was detected between early and modern *Homo* in both buttress angle and thickness. This suggests that neither increased forces in abduction nor increased medial curvature of the iliac blade are the direct cause of the buttress thickening evident in early *Homo*.

Virtual anthropology.

MATTHEW C.S. REID. Anthropology, University of California, Santa Cruz.

Implementing 3D laser scanning and virtualization of skeletal materials, Virtual Anthropology was applied to osteological education. Complete and fragmentary skeletal elements were imaged and the data imported into digital modeling software, creating accurate models for anthropological education and research. Virtual tools and interactive 3D models allow students access to learning materials outside of the classroom and laboratory setting, at little to no cost to the student. Through 3D printing, utilizing the Z Corporation inkjet printed binder into a powder matrix process, highly accurate, full-color, replicas can be created. These models can augment or replace actual osteological specimens, and can even be provided for students to keep through laboratory component fees.

The accuracy of the scans and 3D prints was checked through measurements and physical inspection. After scanning, the digital 3D models were measured in Geomagic to compare height, width, and length measurements of the original bone. Height, width, and length measurements between the original specimen and digital scans varied between ~1.5mm to ~0.40mm. Measurements of the 3D printed models showed that they differed from the originals by ~1.1 to ~0.3mm. The full color printing process provided increased depth and accuracy to the models. Print time and print cost compared to quality is equal to or better than traditional reproduction methods. The price per performance and accuracy of the Virtual Anthropology process allowed the project to be highly successful.

Shape exploration of the third metacarpal capitate facet: implications for early hominin morphology.

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The manus is useful in inferring the manipulative and locomotor capabilities of early hominins since the hand grasps objects and

directly interacts with the substrate during non-bipedal locomotion. Based on observed differences in third metacarpal (Mc3) base morphology, it has been hypothesized that great apes are adapted for stabilization during locomotion, whereas humans are adapted for manipulative behaviors. Researchers have also noted shape differences in the proximal end of the Mc3 between modern humans and *Australopithecus afarensis*. One difference is the shape of the capitate facet, which narrows palmarly in *A. afarensis* relative to modern humans and great apes. The purpose of this research is to explore this difference in a wider comparative context to enhance our understanding of this distinct morphology in *Australopithecus afarensis*.

We collected three-dimensional landmark coordinates on the Mc3 capitate facet in 12 extant species using a Microscribe digitizer. We collected comparable data on *Proconsul heseloni* and *Australopithecus afarensis*. We explored shape variation using principal components analysis and examined covariation between shape and locomotion using partial least-squares. *Australopithecus afarensis* facet shape was similar to that of cercopithecoids and platyrrhines. We also found that distantly related brachiators, *Hylobates* and *Ateles*, had similar facet shapes that were distinct from other anthropoids. Based on this research, we have uncovered a functional signal in this morphology related to brachiation. We also found that, while *Australopithecus afarensis* facet shape is unique within the hominoid clade, it is similar to a range of extant anthropoids.

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Bitrochanteric breadth and calf circumference: predictors of energy expenditure.

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Energy allotted for locomotion cannot be used for growth, maintenance or reproduction; therefore, understanding the factors that influence the amount of energy used is imperative. Because stature and/or leg length can represent size, they influence the amount of energy used in walking, but other morphological parameters are potentially important. In particular, we wondered if measurements of shape would also be predictive of energy expenditure.

Fifteen women walked on a treadmill while their oxygen intake (VO₂) and carbon dioxide (VCO₂) expiration was monitored at five self-selected walking velocities. Each subject began with four minutes of rest to obtain a standing resting metabolic rate, and then alternated between five minutes of walking and four minutes of rest. We measured the waist, hip, thigh, knee, calf, ankle, and foot circumferences of each subject as well as stature, thigh and calf length, bitrochanteric breadth, and mass.

Bitrochanteric breadth ($p < 0.001$) and upper calf circumference ($p < 0.001$) explained 82% of the variation in VO_2 ($R^2 = 0.82$). Body mass was not a significant predictor of VO_2 when bitrochanteric breadth was included in stepwise regression analysis. Additional analysis suggests that VO_2 increases with longer legs but decreases as calf length increases ($p = 0.048$ and 0.028 , respectively), but a larger sample size is necessary to study this further.

These results illustrate that morphological factors other than stature and leg length influence energy expenditure. Future work should aim to include the assessment of more morphological variables and obtain larger sample sizes.

Conservation in a sacred forest: an integrated approach for assessing the long-term conservation potential of Javan gibbons (*Hylobates moloch*) in a human-impacted forest.

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Human/non-human primate interactions are increasingly common as human populations expand near primate habitats, making research on primate response to human presence critical for species living in anthropogenically impacted landscapes. Behaviors that prey species exhibit towards predators (including humans) such as greater levels of vigilance and reduced feeding time are known to limit population size, even when mortality from predation is low. Therefore, these behaviors may be used as indicators of human impact on primate populations. We investigated how Javan gibbons (*Hylobates moloch*) living in a human-impacted sacred forest (Cagar Alam Leuweung Sancang, West Java) adjust to varying levels of human exposure. Data were collected February-April 2009, and August 2010-July 2011. Preliminary analysis of 2 social groups indicates that as the number of encounters with humans increased, most (4/5) individuals reduced time spent feeding (B male 35%-0%, $p=0.0014$; B female 45%-0%, $p=0.0112$; C female 30%-23%, $p=0.0028$; C juvenile 25%-15%, $p=0.001$) and increased time spent resting. Also, as human encounters increased, male gibbons increased vigilance behavior (B male 10%-15%, $p=0.0014$; C male 5%-15%, $p=0.0255$), and female and juvenile gibbons spent more time in higher canopy (B female 23%-73%, $p<0.001$; C female 10%-50%, $p=0.0702$; C juvenile 5 %-50% $p=0.0022$). These results are consistent with the hypothesis that as human presence and encounter rates increase, gibbons alter their behavior in ways consistent with anti-predator behaviors. Assessing how this critically endangered species responds to human presence is a vital part of their ultimate conservation.

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Medieval Polish diet in a world of flux.

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Poland's medieval period was a time of dramatic socioeconomic, political and religious changes having major impacts on human diet and health. We report results of a large-scale stable isotope analysis of skeletons from Poland's Pomeranian region in the Vistula River Valley, focusing on rate of diet change and sex- and status-based diet differences.

Two mortuary samples are from Kaldus, an economic center of the early Piast dynasty located on major trade routes, dating to the 10th-11th and 12th-13th c. Two are from Gruczno, an early medieval settlement complex and later agricultural village on the opposite bank of the Vistula River, dating to the 12th-13th and 13th-14th c. With this sample, diet change could be monitored in ~150 year increments. Bone collagen and carbonate of 65 females, 68 males and numerous animals were assayed. Diagenesis was assessed with Fourier transform infrared spectroscopy.

Diets at Kaldus and Gruczno differed markedly in spite of similar time periods and shared geographic region. Diet at Kaldus was isotopically varied and included more fish and the C₄ plant millet. Diet at Gruczno was more restricted to C₃ terrestrial resources. Diet change through time included a reduction in fish and millet. Isotope ratios of men and women did not differ except during the latest time period, and burial style (e.g.: Christian vs. "pagan"/"antivampire") did not predict isotope signatures. Although some changes in diet concomitant with religious and political upheavals were detected, the most significant influence on diet appears to have been a site's economic function.

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Reconstructing health at Elmina, Ghana: bioarchaeological perspectives of a historic African settlement in the Atlantic world.

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We examine health status and diet in a sample ($n=50$) of eighteenth and nineteenth century African burials excavated within the Elmina settlement, coastal Ghana. As one of the largest settlements on the West African coast, Elmina played a central role in European trade, particularly the trans-Atlantic slave trade. This produced increased population growth and urban density, accompanied by transformations in dietary patterns and subsistence. Archaeological excavations have recovered the largest known burial assemblage from an Atlantic period West

African site. Skeletal indicators of health and diet were analyzed to evaluate the effect of these changing conditions on some of the people who lived in Elmina.

Our results show a low frequency of linear enamel hypoplasias in the sample (13%; 75 anterior teeth assessed), and most of the cases were faint in appearance. Very few cases of periosteal lesions were observed, and the incidence of caries was low. A moderate degree of porotic hyperostosis (39%; 18 individuals assessed) and cribra orbitalia (38%; 13 individuals assessed) was found, predominantly in one area of the settlement believed to have been occupied by less elite members of the community.

Overall, our data do not show a high prevalence of biological stress indicators and suggests good dental health. Until now, very little bioarchaeological research has been conducted on historic West African skeletal populations. This study is a first step towards filling this gap and contributing towards a deeper understanding of both West African populations during the period of the Atlantic trade and African diasporic lifeways.

An experimental analysis of butchery efficiency for Oldowan flakes based on flake size.

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Analysis of humanly-produced lithic flakes is an established archaeological science. Determining intentionality in flake production, however, is difficult. Without experimental understanding of flake production and utility for various tasks, archaeological flakes of varying sizes are uniformly analyzed. This research uses experimental evidence to quantitatively assess the utility of individual Oldowan flakes for meat extraction. Basalt cobbles native to Koobi Fora, Kenya were experimentally reduced using least-effort methodology. 117 flakes were produced and classified in four ascending size groups based on their effective cutting circumference, measured from one platform side to the other. The distal ends of domestic pig (*Sus scrofa domestica*) femora were butchered using replicated flakes of varying size categories to assess the effect of circumference size on butchery efficiency. All femora were professionally butchered for the same meat cuts prior to experimentation; experiments, therefore, model scavenging opportunities in which only meat scraps are available. Experiments were limited to two minutes of butchery for standardization. The difference in bone weight before and after butchery was measured to quantify the amount of meat removed per experiment. Results suggest that flakes with a circumference of 12-19 cm were most effective at removing flesh (MANOVA $p=0.018$). Interestingly, as flakes get very large and very small, their butchery efficiency is reduced. These results imply that analytical limitations may be placed on Koobi Fora Oldowan assemblages in terms of expectations for flake utility. Further, Oldowan flakes of extreme size may be considered unintentionally produced if the intended activity for the flakes was butchery.

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Mobility and subsistence in the Early Intermediate Period cemetery of Villa El Salvador XII.

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Villa El Salvador XII is an Early Intermediate Period (100 BC – AD 100) cemetery from the lower Lurin Valley of central Peru. Analysis of cranial deformation, non-specific health indicators, grave goods and enthesal changes suggest two groups used the site, either local fishers and farmers or local farmers and highland immigrants. These studies indicate that the groups were likely exposed to differential patterns of physical behavior. This project tests this hypothesis by examining the presumed subsistence groups for differences in activity and mobility using cross-sectional geometric properties.

Femoral cross-sectional geometric properties were calculated for a series of 48 anterior-posterior and medial-lateral radiographs (24 males and 24 females), standardized for body size. These data were examined for differences in sex, cranial deformation, and presumed subsistence groups. In general, no significant differences were noted across TA, CA, Ix, Iy, J, and Ix/Iy for cranial deformation and presumed subsistence groups. The average Ix/Iy ratio is 1.02 and 1.00 for males and females, respectively, indicating a relatively round shape that is consistent with less mobile populations. Sex was the only variable to show marginal significance with males exhibiting greater CA ($p=0.052$), J ($p=0.066$), Iy ($p=0.073$), and Ix ($p=0.097$) values. Although expected, these findings suggest that males and females exhibited similar mobility patterns, but that males were engaged in more strenuous physical activity. These results argue against highland immigrants at the while not denying the possibility of sedentary local fishers and farmers in the Villa El Salvador XII cemetery.

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The legacy of slavery and trade: morphometric assessment of 18th century population dynamics at the Cape of Good Hope.

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Recently, human bioarchaeology has developed growing research interests on the analysis of historical populations dated within the last three centuries, and especially in relation to the slave trade. This historical phenomenon is explored here in the 18th century Cape Colony of

the Dutch East India Company. In fact, the latter was a slave state, drawing its labour from Africa, Asia and Europe and therefore acting as a cultural and biological crossroads. For this project, the skeletons under study originate from Cobern Street burial ground (late 18th century, Cape Town, South Africa, N = 39). Previous archaeological and isotopic analyses of skeletons from this cemetery supported the high diversity of origins of people buried there (local populations, slaves from Central and East Africa, Madagascar, India and Indonesia). The objective of this study is to provide additional data on the diverse biological origins of the people of historic Cobern Street, using multivariate craniometrics and a very large comparative sample of potentially ancestral populations. Factor and discriminant analyses are performed using up to 16 standard variables related to the vault, face and cranial base. Preliminary results (distance measures, posterior probabilities) showed very high levels of diversity in this population sample, supporting the hypothesis of the presence of high levels of gene flow not only of African origin but also from both Asia and Europe. These morphometric data agree with recent genetic data showing extreme diversity in present-day Cape Town populations, especially those living groups who are considered to be Cobern Street descendants.

Miocene-to-Recent evolution of the hominin foramen magnum.

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Recent work demonstrates that the human foramen magnum (FM) comprises two functional matrices, ventral and dorsal. The ventral matrix is related to locomotion while the dorsal matrix is related to neural, hemodynamic, and hydrodynamic functions. How these matrices responded to the Mio-Pliocene transition in locomotor function and the Pleistocene transformation in cranial capacity is unknown. As an initial step in addressing these questions, we compared FM and cranial size and shape across fossil (Miocene through Pleistocene) and modern hominin species.

We measured or compiled from the literature lengths and widths of crania and FM, and calculated shape indices, in 92 fossil specimens and 471 modern humans. Standard statistics were employed to compare taxa and explore the relationship between cranial and FM size and shape.

Miocene-to-Recent trends in the cranial index are complicated by non-comparable sample sizes and geographic and temporal variation. In general, pre-*Homo-erectus* hominins have long and narrow crania whereas *Homo erectus*-Anatomically modern humans have longer but also broader crania. Although

cranial capacity increases with *H. habilis*, it is not until *H. erectus* that FM size increases dramatically; it's then relatively stable throughout Pleistocene-to-Recent times. An exception is the increased FM breadths, but not lengths, in East African robusts.

Modification of FM matrices has important selective consequences. However, in pre-*Homo-erectus* hominins exclusive of East African robusts, FM size sufficiently accommodated locomotor changes and brain size increases. With the evolution of *H. erectus*, FM size initially increases but stabilizes, even though cranial size and shape continue to undergo significant modifications.

Isotope studies of prehistoric diets on the Northwest Coast of Canada.

MICHAEL P. RICHARDS. Anthropology, University of British Columbia.

This poster will bring together recent and published dietary isotope data for prehistoric humans and dogs from the Northwest Coast of Canada. This area was one of the first areas in the world where isotope analysis was applied, and recently, in collaboration with First Nations communities, new analysis has been undertaken to help determine past indigenous diets and resource use in this region. Early studies focused mainly on carbon isotopes in bone collagen and showed the overwhelming importance of marine foods in diets for people along the coast. More recent research on dogs has included measurements of collagen nitrogen isotopes that can help to identify the specific types of marine foods consumed. Those studies showed that the main dietary protein sources for the dogs were likely lower trophic level marine foods, and not salmon, which was often argued as the primary marine food consumed in coastal prehistoric British Columbia. In this poster we present new human and dog carbon and nitrogen isotope data which, although the dataset is limited at this stage of the project, does show that salmon was the most likely main source of protein for humans along the Northwest Coast.

An independent validation using CT data of two methods to quantify uniqueness in the frontal sinuses for forensic anthropological applications.

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Identification of unknown individuals is important in forensic cases to notify next of kin and to execute legal matters. Several areas in the skeleton have been proposed to aid in identification, including the frontal sinuses. These structures are considered unique to each individual because of the high degree of observed morphological variation. Due to their location inside the skull, between the inner and outer tables of the frontal bone, visualisation of the frontal sinuses is achieved through

radiographic imaging, typically X-Ray or computed tomography (CT). Basic visual comparison, overlaying an antemortem image and a postmortem image to identify a match, has given way to several methods that have attempted to quantify observed morphological variation. Recently, owing to the *Daubert* ruling, an increased emphasis has been placed on quantification and testing to develop accurate and replicable methods within forensic anthropology. It is therefore crucial that all personal identification methods be tested and validated on independent samples.

Ribeiro's method from 2000 and Reichs and Dorion's method from 1992 for quantifying uniqueness in the frontal sinuses were compared, using an independent postmortem CT data sample. The protocols developed are described and the methodologies are evaluated for their ability to characterize individuality in this sample. Observations of Ribeiro's measurement method suggest high levels of accuracy and repeatability compared with Reichs and Dorion's coding system. The results of test cases to identify matches for each technique are presented and recommendations for practical application discussed.

Funded by SSHRC.

Using modern taxa to understand biomechanical variables: interpreting function from fossil footprints.

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The uniqueness of extinct species presents a profound obstacle to reconstructing function from fossilized remains. While researchers often study functional morphology in modern species to make inferences about function in extinct species, inherent assumptions must be made when attempting to use modern taxa as models for extinct ones. We argue that the most productive approach involves understanding the variables in biomechanical systems such that those variables can be investigated in extinct taxa, even when they have unique morphologies. Here, we provide an example of this approach with our efforts to interpret foot function and anatomy from footprints made by extinct hominins 1.52 million years ago at FwJj14E near Ileret, Kenya.

To better understand how gait and foot shape and function influence footprint formation, we conducted experiments with thirty-eight habitually unshod and minimally-shod Daasanach adults who walked and ran across a pressure pad and made footprints in rehydrated fossil footprint sediment excavated from an Ileret footprint layer. At walking speeds, the depths within footprints show a significant relationship ($p < 0.0001$) with peak pressure across most anatomical locations. Interestingly, fossil footprint shapes (relative depths) differed

significantly from those of the experimental footprints, despite the comparable sizes and speeds of the prints made by the Daasanach subjects walking on the same sediment. Instead of using modern human samples as "models" from which to infer function, we suggest that unique gait and/or foot anatomy can be interpreted via an understanding of the relationships among the variables, such as pedal pressures, gait parameters, and footprint structure.

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Why the long face? Disease phenotypes as a window on evolutionary change.

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A variety of traits have emerged or, conversely been lost during primate evolution. The development of facial prognathism, a complex trait that varies between primate species, results from the interaction of soft tissue composites and the facial skeleton. Evolutionary changes in facial prognathism do not result from independent changes in individual tissues, but from coordinated changes in developmental interactions among diversified cells and tissues. Identifying the gene networks underlying such traits in evolutionary lineages is difficult, if not impossible, even when rich fossil records exist. Identifying candidate genes and developmental dynamics for these traits in laboratory organisms poses a less challenging problem.

Midfacial hypoplasia is a diagnostic character of hundreds of human diseases and transgenic mice carrying the orthologue of some causative human mutations are available. We use data from μ CT and μ MR images and histological sections to characterize phenotypic variation of the midface in mice carrying different mutations of fibroblast growth factor receptor 2 and 3 genes (*Fgfr2* and *Fgfr3*). Each mouse model shows generalized midfacial hypoplasia, but facial bones, soft tissue structures, and facial sutures are affected differentially depending upon the exact mutation expressed. Analyses of these mouse models shed light on various developmental changes that might lead to an evolutionary reduction in facial prognathism. Although *Fgfr2* and *Fgfr3* may not be "the" genes "for" facial prognathism in primate evolution, understanding their impact on facial development and the networks in which they function can generate predictions about suites of

traits that evolve together due to shared genetic causes

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Bioarchaeological analysis of the Miami One 8DA11 skeletal remains: a glimpse into the population's past health and population structure.

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Little is known about Florida prehistoric populations through the use of skeletal data. Heretofore, documented archaeological and osteological analyses have focused on Contact period populations. The Miami One site (8DA11) provides an opportunity to review one of the largest and oldest ossuaries in the USA, and through bioarchaeological analyses provide insight into the population structure, history and health of a Floridian Native American group.

The purpose of this paper is to analyze paleo-epidemiology and paleo-demography for feature 222 dating from the Archaic to Glades II (1000 BC-1000AD) period in Southern Florida through descriptive and quantitative tests. MNI was obtained by determining the frequency of sided petrous bones. This increased the accuracy in determining MNI in comparison to other severely fragmented bones observed.

The preliminary results indicate that the MNI is 103 adults (65.6%) and 54 sub-adults (34.3%). We hypothesized that sub-adults--encompassing 50% of most population structures--would be underrepresented due to difficulties in the preservation of sub-adult remains. Pathology was hypothesized to be infrequent for this non-agrarian population. Supporting our hypothesis, binomial tests show statistical significance between the number of adults and sub-adults represented, $p = .000$, $\alpha < 0.05$. Pathology was observed in 15.5% of the adult population (16 individuals) and 14.8% of the sub-adult population (8 individuals). The high density of remains was also found to be unexpected for assumed archaic environmental conditions and burial practices. Ongoing research aims to analyze features: 223, 224 and 1539 to further develop a record of health, culture, variation and ancestry for this past population.

Moche amputation: punishment or pathology?

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The pre-Columbian Moche of Peru, 50-100 AD – 800-950 AD, are often defined through their unique ceramics and artistic

representations. Within these artistic images of their culture, a distinctive trend emerges regarding the amputation of limbs, primarily feet, and the mutilation of the face, primarily the nose and lips. Evidence of these amputations is also observed in the skeletal remains of the Moche people. In much of the literature concerning the Moche, it is hypothesized that these foot amputations and facial mutilations are primarily the result of punitive actions.

The results of this study suggest that the foot amputations, along with the nose and lip disfigurements, represented on Moche ceramic vessels are overall more consistent with a pathology and reactive surgical contexts rather than punitive practices. To support this hypothesis, a division and reinterpretation of the content and meaning between Moche fine-line artistic representations and iconographic ceramic vessels is made, and Moche cultural identity and practices of amputation are explored. Skeletal remains with evidence of amputation and disfigurement from the Moche sites of El Brujo and Mocollope are used to address the possible reasons (e.g., leprosy, syphilis, tuberculosis, Chagas' disease, leishmaniasis, punishment) for these skeletal modifications. The results of this study provide us with a new perspective of Moche culture, which is valuable for future studies.

Derived anatomy of the shoulder and wrist enable throwing ability in *Homo*.

NEIL T. ROACH and DANIEL E. LIEBERMAN. Department of Human Evolutionary Biology, Harvard University.

Throwing with power and accuracy is a uniquely human behavior and a potentially important mode of early hunting. Chimpanzees, our closest living relatives, do occasionally throw. However, chimpanzee throws differ kinematically from human throws and have much lower accuracy and speed. At some point in our evolutionary history, hominins developed the ability to produce high performance throws. The anatomical changes that enable this increased throwing ability are poorly understood and the antiquity of this behavior is unknown.

This study tests a biomechanical model relating how anatomical shifts to the shoulder and wrist that occur during human evolution affect measures of throwing performance. Kinematic data were collected from 24 male, collegiate athletes. Subjects performed a series of normal throws and restricted throws in which braces were used to limit joint motion, modeling chimpanzee range of motion. Inverse dynamics analysis was performed to calculate joint velocities and torques. Four anatomical factors, all identifiable in the fossil record, are shown to significantly affect angular acceleration and power production in the wrist and shoulder: humeral torsion, wrist hyperextensibility, glenoid orientation and relative clavicle length. In each case the shift from a chimpanzee-like morphology to a human morphology significantly increased joint power and projectile speed. The fossil record indicates these morphological changes occurred in a mosaic-like fashion during human evolution. Our results provide insight into the high performance throwing ability of *Homo erectus*.

This study was generously funded by the National Science Foundation, BCS - 0961943 (Roach and Lieberman).

Understanding re-emerging infectious diseases: contributions on tuberculosis from palaeopathology and biomolecular science.

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Tuberculosis (TB), caused by *M. tuberculosis* complex (MTBC) organisms, is a re-emerging infectious disease. It is estimated to be 3 million years old, originating in Africa. First clear historical evidence dates to 2700 BC (China), the first skeletal evidence to 5800±90 BP (Italy), and in Britain to the Iron Age (400–230 BC). Key questions remain about how, when and where TB originated. *M. tuberculosis* has extensive genetic variation which has partly a geographical basis. The aim of this paper is to describe a current project focusing on the origin and evolution of the causative agents of TB in Britain and other parts of Europe. Using real time PCR assays of IS6110, IS1081 and rpoB targets, bone samples from 488 individuals have been analysed for *M. tuberculosis* complex DNA (177 European; 64 sites, and 311 British; 78 sites; 500BC-19th century AD). These analyses produced 148 positive samples for MTBC. 101 of those extracts that contained authentic *M. tuberculosis* complex DNA were further analysed to distinguish between members of the complex and to obtain strain data (through next generation sequencing - NGS). Using two strategies: hybridization capture directed at 262 different regions of the MTBC genome, and also at the entire genome, up to several million sequences have been identified with many samples at many sites, with up to 8% corresponding to organisms of the MTBC. The final NGS results will have implications for understanding how TB bacterial strains have evolved, and what that might mean for TB's future.

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The Bruce effect in a wild primate.

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Female rodents are known to terminate pregnancies after exposure to unfamiliar males ("Bruce effect"). Although laboratory support

abounds, direct evidence for a Bruce effect under natural conditions is lacking, and no study has yet demonstrated a fitness advantage for females. Here, we report a strong Bruce effect in a wild primate, the gelada (*Theropithecus gelada*). Female geladas terminate 80% of pregnancies in the weeks after a dominant male is replaced. Further, data on interbirth intervals suggest that pregnancy termination offers fitness benefits for females whose offspring would otherwise be susceptible to infanticide. Taken together, data support the hypothesis that the Bruce effect is an adaptive strategy for females of some species.

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Geometric morphometric analysis of shape variation in the mandible of fossil and extant hominoids.

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Mandibular morphology figures prominently in our understanding of human and ape evolution, with many features considered important to taxonomic and phylogenetic hypotheses of hominoid evolution. Nevertheless, 3D geometric morphometric studies have largely neglected the hominoid mandible, and none has investigated variation both within and among fossil and extant hominoids. Here, we present results from a series of morphometric analyses based on large samples of extant hominoid mandibles and several important fossil specimens.

The 3D landmark data we analyzed clearly distinguish between species and even subspecies of extant hominoids. Compared to a recent discriminant analysis based on linear data (Lague et al. 2008), the landmark analyses performed equally well at distinguishing between subspecies of *P. troglodytes* and performed better in discriminations among subspecies of *G. gorilla* and *Po. pygmaeus*, and species of *Pan*. Interestingly, phenetic relationships among extant genera show similarities between *Pan* and *Pongo* and between *Symphalangus* and *Gorilla*. Among the fossils, there is substantial variation within the genus *Australopithecus*. Whereas *A. afarensis* specimens are most similar to those of *Gorilla*, the *A. africanus* mandible is closest to *Pan*, and particularly to *P. paniscus*.

Cortisol and reproductive state in female black-handed spider monkeys.

MICHELLE A. RODRIGUES and DAWN M. KITCHEN. Department of Anthropology, The Ohio State University.

Fecal glucocorticoid metabolites (e.g., cortisol) are a valuable non-invasive source of information on individual levels of physiological stress. However, using them to evaluate stress levels among females can be problematic in species that do not show overt signs of reproductive condition because concentrations of reproductive hormones can affect cortisol concentrations. For example, high concentrations of estradiol during pregnancy may promote an increase in glucocorticoids and associated binding factors. Here, we examine the efficacy of using fecal glucocorticoid metabolites as an indicator of stress and whether estradiol is a potential confound of such measurements in both wild (El Zota, Costa Rica) and captive (Brookfield Zoo, Illinois) black-handed spider monkeys (*Ateles geoffroyi*). First, fecal cortisol concentrations were measured from captive female spider monkeys before and after a veterinary exam. All females exhibited elevated cortisol concentrations after this stressful experience, though concentrations were highly variable among individuals in both conditions. Second, we examined the relationship between cortisol and estradiol concentrations in captive and wild females. In the captive samples all females were cycling and cortisol and estradiol levels were not related ($N=22$, $r=0.177$ two-tailed $p=0.431$). However, in the wild sample, which included nursing, cycling, and pregnant females, cortisol and estradiol were positively correlated ($N=24$, $r=0.700$, two-tailed $p<0.001$). Thus, we demonstrate the need to examine estradiol concentrations when measuring cortisol concentrations among females of unknown reproductive condition. We are currently examining how cortisol concentrations vary among female spider monkeys based on social and environmental factors as well as age, rank and reproductive state.

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Viruses on low-carb diets: the possible role of a cell surface carbohydrate in the evolution of resistance to viral infections in catarrhines.

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Due to the inactivation of the α 1-3 galactosyltransferase (GT) gene approximately 28 MYA, the carbohydrate α Gal is not expressed on the cells of Catarrhini, but is expressed in all other mammals. Viruses can utilize host cell carbohydrates in various ways such as binding receptors or attachment proteins. We found that susceptibility to certain viral infections is tied to the presence or absence of α Gal on the surface of host cells. We show that Sindbis virus (Alphavirus) replicates well in α Gal-positive cells but herpes simplex viruses (HSV-1 and HSV-2) preferentially grow in cells lacking α Gal. In both cases, differences in infection levels result from the ability of the virus to successfully initiate infection. This points to a

role for α Gal in the early stages of viral infections. We also show that GT knockout mice infected with HSV-2 have higher viral load and greater pathology compared to WT B6 mice that naturally express α Gal. This is clear evidence that the presence or absence of α Gal in cells or animal hosts has an effect on the course of viral infections. Our results have implications for the evolution of resistance to viral infections in catarrhines. Pathogens exert great selective pressure on their hosts, and it is possible that a pathogen, able to exploit α Gal, could have helped shape primate lineage evolution during the Oligocene.

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Post-European contact Native American female and male population histories inferred from the analysis of mitochondrial DNA and Y-chromosomes.

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Mitochondrial genomes, which are maternally inherited, and Y-chromosomes, which are paternally inherited, can be used to infer the population history of females and males, respectively. Addressing the question of the effects of European contact in Native American communities, we extracted DNA from buccal swabs/saliva from nearly 100 individuals from three First Nation communities in British Columbia, Canada. Specifically, we determined the mitochondrial DNA haplogroup by sequencing the Control Region of the mitochondrial genome. In addition, we determined the Y-chromosome haplogroup by genotyping diagnostic SNPs using ABI Taqman assays. Our results show a consistent pattern for all three populations where Y-chromosomes inferred to be of European origin are in higher frequency relative to mitochondrial genomes inferred to be of European origin. The results suggest that following European contact, European males admixed with Native American females in higher frequency than European females admixing with Native American males in British Columbia. This interpretation of the DNA analysis agrees with documents and accounts of the history of British Columbia.

Using artificial selection in mice to understand the mechanisms of human skeletal evolution.

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Among primates, hominoids show considerable interspecific variation in limb bone length, both in terms of intra- and intermembral proportions, and also in relation to body size. These differences are thought to have evolved in

response to selective pressures relating to different locomotor behaviors. However, the genetic and developmental mechanisms that made this interspecific variation possible in the first place remain largely unknown. Here I present preliminary data from an ongoing artificial selection experiment in mice, designed to address the developmental and genetic basis of skeletal variation in vertebrates. In this experiment, two lines of CD1 mice are selectively bred for increases in relative tibia length, and matched against a control line. The objective is to produce a population of mice in which artificially introduced differences in tibia length can be traced back to their developmental and genetic underpinnings, while permitting *in vivo* observations of skeletal evolution. Preliminary results from three generations of selection indicate a relatively high heritability of tibia length, leading to a response to selection of ~1.5% tibia length per generation. Developmental and genetic analyses will begin by generation F8, providing for the first time an opportunity to deconstruct a quantitative trait from phenotype to developmental process(es) to genotype. Applications of this unique vertebrate model for understanding the evolution of derived limb proportions of humans and early hominids are also discussed.

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Geometric morphometric analysis of the upper first molar in modern hunter-gatherer populations.

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Tooth morphology shows a large variability; however it remains unclear which is the relation, if any, between it and environmental conditions. In this exploratory work we start to observe if tooth morphology varies following large climatic conditions. The morphology of upper first molar (M1) of six modern hunter-gatherer populations from hot-humid ($n=18$; Central African Baka-Aka pygmies and Andaman islanders), hot-dry ($n=20$; South African Khoesan and south-western Australian Aborigines) and cold-humid ($n=17$; Greenland Inuit and Yamana from Tierra del Fuego) climates was analysed by Principal components analysis (PCA) of Procrustes shape coordinates and by canonical variates (CV). The PCA of the relative warp scores shows that populations living in cold-humid environments characterize by an expanded and square occlusal polygon with a reduced hypocone, whereas those inhabiting in hot (dry and humid) climates present a bigger hypocone and a reduction in the distance between the protocone and the hypocone. Changes in shape are not allometric. The canonical analysis enables to distinguish

clearly the Inuit from Yamana (Goodall's F-test $P < 0.001$). Populations from hot climates distribute along the first CV axis (41.3% of the total variance), Khoesan differs from SW Australian Aborigines ($P < 0.001$) and Andaman islanders distinguish from Baka-Aka pygmies ($P < 0.001$). This work is only based on a single tooth class and random factors cannot be disregarded, however the results seem to suggest that differences in the morphology of the upper M1 are not related to climatic conditions and others factors can probably better explain it.

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The soundness of the Cheverud Conjecture and its implications for the study of human evolution.

CHARLES C. ROSEMAN. Anthropology and Illinois Informatics Institute, University of Illinois.

The Cheverud Conjecture (CC) states that genetic and phenotypic covariance matrices (G and P, respectively) are very nearly proportional for morphological characteristics. If the CC holds, estimates of selection gradients, estimates of the degree of divergence among groups, and tests of the neutral model of phenotypic evolution derived using P will be proportional to those calculated using G. This would be convenient for those who wish to use evolutionary quantitative genetic theory and method to test hypotheses about evolutionary process in humans and other primates as it is extraordinarily difficult to estimate G in most species of primates. Using published estimates of G and P, I test a series of hypotheses meant to judge the soundness of the CC and the sensitivity of evolutionary quantitative genetic tests to violations of the proportionality assumption. Almost without exception, the CC holds, and G and P appear to be proportional when the vagaries of sampling are taken into account. Uncertainty in estimates of P due to sampling and the undue effects of the badly estimated dimensions of P and G are much more pressing issues for the study of the effects of selection and drift on the evolution of morphology. Estimates of P are adequate to answer some, but not all, questions about the evolution of morphology in humans and other primates. Quantitative genetic investigations into how P and G evolve are critical for understanding the causes of the differences among primates in their patterns of modularity and integration.

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Do food material properties impact mandible morphology in primates?

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The available data suggest weak or nonexistent relationships between food material properties (FMPs) and mandible morphology among primates.

We present data on 3-d jaw kinematics in *Cebus* and *Macaca* eating foods of known material properties (FMPs). Using a random, nested ANOVA model with four hierarchical factors, we show that, controlling for variance within sequences and between individuals, FMPs do significantly impact 3-d jaw kinematics during the power stroke in both macaques and capuchins: tougher foods are chewed with more vertical jaw movements. There are also species-level effects on jaw kinematics that may be linked to differences in occlusal or TMJ morphology. Specifically, the finite-helical axis of the mandible is located closer to the jaw joint in capuchins than in macaques, possibly related to the larger articular eminence in the former. These data suggest that FMPs do impact chewing behavior. Whether these differences are associated with differences in mandibular strain patterns is currently being investigated.

We also evaluated whether increases in body size can be expected to be associated with increases in the number of chews per day, as predicted by hypotheses explaining size related influences on symphyseal fusion with reference to fatigue loading of the mandible. Once daily feeding time data from the literature are corrected for scaling of chew cycle time, no significant effect of body size on daily chew number is evident. This suggests that size related effects on symphyseal and corpus morphology are not due to changes in number of chews per day.

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Fossil forelimbs of *Simiolus* from Moruorot, Kenya.

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The "small apes" of the African early Miocene are very poorly represented by postcranial material. Associated elements of these species are even rarer, consisting mainly of several partial limb bones of *Dendropithecus* from Rusinga Island. Previous collecting at the early Miocene site of Moruorot in Northwest Kenya produced a distal humerus and radial fragments from a small ape (Rose et al. 1992, *J Hum Evol* 22:171-237). Our ongoing excavations at Moruorot have recovered additional material apparently belonging to the same individual, including conjoining segments of the previously collected radius. To date, these include most of the left arm and forearm and portions of the right forelimb, including an exceptionally preserved almost complete right hand. Attribution of this material to the genus *Simiolus* is based on similarities to the few *Simiolus* elements known from Kalodir, along with significant differences from *Dendropithecus* that our new fossils make evident.

This new material adds considerably to our understanding of the postcranial morphology of *Simiolus*, and reveals some diversity in positional behavior among the small non-cercopithecoid catarrhines of the early Miocene. *Simiolus* had more elongated forearms than *Dendropithecus* as well as relatively long metacarpals and phalanges, suggesting enhanced manual grasping and reaching/bridging abilities. However, *Simiolus* retained a proximally protruding (though short) ulnar olecranon process, as well as styloid-triquetral contact in the wrist. The discovery of fossil catarrhines possessing such trait combinations is our only means of discovering the pattern of mosaic evolution that lead to the crown hominoid postcranium.

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Nutritional contributions of insects to primate diets.

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Almost every primate accidentally or intentionally eats insects. The portions of insects in primate diets varies from large to small; a major portion of the diets of smaller primates (<1 kg) are insects, while most folivorous primates do not deliberately incorporate insects in their diets to a large extent. Consumed insects provide substantial amounts of energy, protein, and minerals, depending on the type of insect consumed and its amount in the diet. Here, we review the nutritional contributions to insect diets by synthesizing all published data on the nutrients in insects consumed by primates, from aye-ayes (*Daubentonia madagascarensis*) to gorillas (*Gorilla gorilla*). We use a new framework of nutritional ecology, the right angled mixture triangle, to compare insects with other primate diet items, and human entomophagy. Our results suggest that in general social insects consumed by primates provide more energy per gram than solitary insects, which provide more protein. All types of insects typically provided more protein than leaves, and many provided more energy than fruits. In addition, insects provide a major source of sodium, which is typically limited in primate diets. Intraspecific variability was evident in that different insect stages provided differing amounts of nutrients. Our results highlight the importance of insects in primate diets and call for more investigations into the nutritional content of insects eaten by primates.

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New data from an old site: Neandertals at Goyet (Belgium) and their mortuary behavior.

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The "Troisième caverne" of Goyet (Belgium), excavated at the end of the 19th and early 20th century, yielded a rich archeological sequence ranging from the Middle and Upper Paleolithic to historical times. In 2008, we began to document the Paleolithic occupations of the "Troisième caverne" by reassessing the collections recovered from the site which heretofore had only been partially studied. The updated inventory of human remains was completed by sorting out the paleontological collections in order to identify human remains that had been overlooked thus far. As a result, the collections from the "Troisième caverne" now include nearly 200 human bones/bone fragments and isolated teeth that correspond to various material from different periods.

The morphometric study of the human specimens from Goyet, completed by radiocarbon dating and stable isotope analysis, shows that the sample contains a large although fragmentary series of Late Neandertal remains. They include elements from the cranial and infra-cranial skeleton and represent at least 3 different individuals. The Neandertal specimens of Goyet also present numerous anthropogenic traces that are similar to those found on the fauna remains from the site. We interpret them as evidence of cannibalism and will discuss our observations in terms of mortuary behavior variability among Neandertals.

This research is part of an ongoing effort within the paleoanthropological community to revisit sites and fossils that were discovered over 100 years ago in order to reassess them using modern techniques.

This research was funded by the Wenner-Gren Foundation (Gr. 7837), the College of Social and Behavioral Sciences of CSUN, and the CSUN Probationary Faculty Support Program.

Tobacco, cannabis, parasites, and life history strategies in hunter-gatherers from the Central African Republic.

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Tobacco use is responsible for 20% of mortality in the US and Europe, 12% of global mortality, and, in developed countries, is the single largest contributor to disease burden. Despite these statistics, the widespread recreational use of tobacco and other psychoactive plant drugs has received little attention from biological anthropologists.

Studies in Western societies find that substance use is associated with a suite of risk-taking behaviors and is often predicted by impulsivity constructs. There is also a cross-

national male bias in substance use. Although nicotine is not thought to be a carcinogen or the direct cause of chronic tobacco-related health problems, it is nevertheless a potent neurotoxin, with a toxicity in humans comparable to hydrogen cyanide. It is an equally potent neuroteratogen, with negative effects on the development of the central and peripheral nervous systems in fetuses, children and adolescents. Nicotine, THC, and other components of tobacco and cannabis also have antiparasitic properties.

We therefore investigated the interaction of substance use and age- and sex-specific life history strategies linked to toxin avoidance, parasite load, risk seeking, and competition for mates among a population of Aka forest foragers in the Central African Republic. Data include demographic information on 1088 Aka, peer ratings of substance use for 150 Aka, and self-reports, saliva and urine samples from 68 Aka. Results generally support a life history and sexual selection theory approach to substance use.

This investigation was supported in part by funds provided for medical and biological research by the State of Washington Initiative Measure No. 171.

The impact of variation in the progesterone receptor gene, life history and lifestyle on endometrial function and the menstrual cycle.

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Interest in women's reproductive variation within the subfield of Physical Anthropology known as Human Reproductive Ecology is dominated by energetic models for fecundity that seldom consider genetic variation as a potential cause of differences in reproduction. A polymorphism in the progesterone receptor gene, called PROGINS, shows diminished progesterone response *in vitro* and is associated with several uterine disorders in women. We screened healthy Philadelphia women (N=94, aged 20-45 with no oral contraceptive use < 3mo prior to enrollment) for the PROGINS variant. Eighteen PROGINS carriers and 34 non-carriers recorded menstrual diaries and physical activity data over 3 menstrual cycles. In the third menstrual cycle daily saliva samples were collected and subjects had transvaginal ultrasound to measure mid-luteal endometrial thickness. We also assessed evidence for gene-environment interactions between the PROGINS variant and other factors such as salivary progesterone, anthropometric measures, physical activity, age, and age at menarche using moderated regression techniques. While endometrial thickness did not differ between the two groups, PROGINS carriers had luteal phases that were 2.1 days shorter than those of non-carriers (p=0.016). PROGINS also modified the relationships between menstrual cycle length and mean mid-luteal progesterone, anthropometric measures

and physical activity. Further, PROGINS modified the relationship between endometrial thickness and BMI. These findings indicate that PROGINS alters endometrial sensitivity not only to progesterone, but also to acute and chronic energetic stress. Our results suggest that Human Reproductive Ecologists will benefit by incorporating genetically-based variation in sensitivity to energetic stress in future adaptive models of women's reproduction.

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Genetic factors influence serological measures of common, chronic infections in Alaskan Eskimo participants in the GOCADAN study.

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Individuals and populations differ in regard to susceptibility or resistance to infectious disease. Here we examine whether genetic factors contribute to variation in antibody titer, which represents history of infection with a particular pathogen, in Alaskan Eskimos (primarily Inupiat). Participants included ~500 family members from the Norton Sound region of Alaska, who take part in the Genetics of Coronary Artery Disease in Alaskan Natives (GOCADAN) study. Antibody titers and seroprevalence were determined at two time points, approximately 15 years apart. IgG antibody levels were determined using ELISA for: *Helicobacter pylori* (*Hp*), cytomegalovirus (CMV), herpes simplex virus-1 (HSV-1) and -2 (HSV-2); and IgG, IgA, and IgM antibodies to *Chlamydomphila pneumoniae* (*Cp*) were quantified by microimmunofluorescence. Additive genetic heritability (h^2) was calculated using variance component (VC) pedigree analysis with the computer program SOLAR. Genome-wide linkage analysis was performed using 383 STRs. Seroprevalence rates indicate that infection with these pathogens is common (>75% for *Hp*, CMV, and HSV-1) and chronic (seroreversion rates are <1% to 10% over ~15 years). Heritability estimates are significant for four pathogens, with h^2 ranging from 0.33 to 0.61 (for *Hp* and *Cp*, respectively). Results for HSV-2, the only sexually transmitted pathogen examined, are not significant. Significant genome-wide linkage results were obtained for *Cp*, with a maximum LOD score of 4.84 on chromosome 8. These results demonstrate that individual genetic differences influence antibody measures of common infections in this population. Further investigation may identify specific genetic factors that contribute to infection susceptibility and elucidate the underlying immunological processes involved.

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Osteological manifestation and diagnosis of Cocaine-Induced Midline Destructive Lesion: a new understanding of an overlooked condition and its relevance to forensic anthropology.

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Cocaine-Induced Midline Destructive Lesion (CIMDL) has never been described from the osteological perspective despite the significant destruction of bone it can cause. Although several clinical publications describe case studies, the bony changes associated with CIMDL are rarely described in any real detail. Many authors write them off as "non-specific," yet admit that they are uncertain of what these changes entail. The present study suggests that greater focus on the osteological manifestations of CIMDL may aid both clinical and forensic diagnosis.

This study analyzed 88 published cases of CIMDL to synthesize a new understanding of its osteological effect. Of the reported patients, 94% exhibit destruction of the bony septum, and over 52% have perforations in the palatal process of their maxillae. Destruction affects the nasal conchae and the paranasal sinuses to varying degrees; the alveolus is typically spared and the nasal bones proper are unaffected. Evidence, not previously associated with CIMDL, further suggests that cocaine is toxic to osteoblasts and thereby inhibits new bone growth, and in no case report is proliferative or sclerotic bone reaction associated with a primary CIMDL lesion.

The ability to diagnose CIMDL is particularly relevant to forensic anthropology; reports show that drug misusers have mortality rates six-times greater than age-matched populations and that 73% of autopsy subjects with cocaine in their systems die from trauma, 70% due to homicide. Drug abuse is not an uncommon feature of Jane and John Does, and recognition of CIMDL in remains may provide vital insight into their deaths and lives.

An analysis of methods and importance of interobserver error in odontometric studies.

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Interobserver error should be a concern for any study utilizing data collected by multiple individuals. The issue is of particular significance for investigations involving odontometrics because there are several different measurement methods commonly used by physical anthropologists. While the underlying information being sought after is often the same, different measurement protocols result in data that are incompatible. Even when attempting to adhere to specific measurement guidelines, published method descriptions tend to be ambiguous and difficult to replicate in practice. This introduces the complication of individual interpretation in determining the location of

measurement landmarks, limiting the degree to which future research can build on existing datasets.

The purpose of this paper is to review commonly used methods for measuring dental remains as well as present the results of an interobserver error study completed by the authors. Research was conducted over a period of one year with measurements being recorded on the same specimens by both authors at three separate intervals. Substantial decrease of interobserver measurement error over time highlights the importance that experience plays in obtaining consistent results. Because teeth are small, variable structures, open dialog between observers during the process permitted fine-tuning of the measurement procedure for questionable or difficult specimens. Based on these findings it is suggested that interobserver error is important to consider both at the onset and completion of a project.

This study was funded by the David C. Skomp Fellowship Fund of the Department of Anthropology, Indiana University.

Mortality of a Swiss urban population in the early 19th century.

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This study reconstructs the mortality of the city of Bern, Switzerland, between 1805 and 1815. It is a contribution to the research on demographics and public health of urban populations of preindustrial Europe. The key source is the Bernese Burial Register which contains various information about the deceased, such as age, sex, and cause of death. It is one of the earliest compilations of data sets of individuals with this high degree of completeness and consistency.

On behalf of life tables, mortality rates of all ages and both sexes were calculated. The susceptibility of specific age groups to certain causes of death was determined. Special attention was given to the cause of death and mortality of newborn infants and birth giving women.

Death by metabolic disorders, illness of the respiratory system, and debilitation were the most prominent causes in Bern. The worst killers of infants were the cramps, a lethal disease with spasmodic convulsions. 5.3% of all births were stillborn. Maternal death in childbed was rarely registered in Bern and there is no specific increase of female probability of dying.

In comparison with Central European data, Bern's mortality structure was typical for cities of the early 19th century. However, Bern's infant and children mortality was especially low.

This research has an explicit interdisciplinary value for different scientific fields from both the humanities and natural sciences.

New techniques for estimating stature and body mass in European skeletal samples.

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Previous methods for estimating stature and body mass from European skeletal remains have generally relied on small and/or possibly unrepresentative reference samples. Here we develop new equations based on a very large, temporally and geographically wide sampling of European skeletal material. Anatomical (Fully) statures were calculated for 501 individuals spanning the Neolithic through 20th century, and from Scandinavia to the Mediterranean region. Sex-specific RMA regressions of anatomical stature on femoral, tibial, humeral, and radial maximum lengths were derived, with %SEEs of less than 2% for the femur and about 2.5% for the humerus and radius. Region-specific (northern and southern European) equations are more accurate for the tibia, but other bones show no marked geographic trends. There are no marked temporal trends in prediction accuracy. Body mass was calculated based on reconstructed stature and bi-iliac (maximum pelvic) breadth for 1170 individuals using currently available equations based on a worldwide sample. Sex-specific RMA prediction equations from the femoral head were then generated from these body mass estimates. Average directional prediction errors for the femoral head equations are small (<1%), as are average random errors (7%). These new equations are broadly applicable to Holocene European skeletal material and provide a more accurate means to estimate and compare body size in past populations from this region.

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Comparison of *Alouatta* male and female limb bone properties.

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Alouatta humeral and femoral properties were examined for sex differences. Possible age-related differences were also explored. The first expectation was that males would have greater humeral midshaft cross-sectional properties relative to body mass than females. The second expectation was that older age categories would show decreased cortical thickness compared to younger adult age categories. Both of these expectations were based on human patterns.

The sample consisted of wild *Alouatta caraya* (N = 20), *A. palliata* (N = 20), and *A. seniculus* (N = 21) specimens sorted into age categories based on patterns of dentition and epiphyseal fusion. Most had associated body masses. Properties analyzed include humeral and femoral lengths, midshaft cross-sectional cortical

and total areas, and femoral head optical density. Age categories were compared using t-tests. Data were log-transformed prior to least squares regression of variables. Future work includes fitting the data using reduced major axis. ANOVA was used to compare slopes and elevations.

Results indicate that *Alouatta* males have greater humeral properties, relative to body mass. This supports the expectation that males have more robust forelimbs than females. Results also indicate that females have greater femoral head optical density than males, compared to body mass. Optical density graphs show considerable scatter so this result is viewed with caution. Comparisons of age categories within both male and female samples do not indicate that older monkeys have thinner cortices or lower femoral head mass. Perhaps few feral monkeys reach senescence.

Social network analysis with insights for disease transmission dynamics in wild chimpanzees.

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In recent decades, infectious diseases have threatened the health and persistence of Africa's endangered apes. While social structure and the topology of contact networks can influence disease transmission dynamics, few studies have quantified wildlife contact networks to inform wildlife disease management strategies. Our work uses field-collected behavioral data to quantify contact rates and to provide a social network structure necessary for modeling disease transmission. Over a 10-month study period, we recorded the frequency and type of social interactions for a community of wild chimpanzees (N=50) in Kibale Forest, Uganda. Using generalized linear mixed models and social network analysis, we examined contact variability among community members and evaluated the importance of both individual and environmental explanatory variables. We also used node-level regression to assess how various social factors affect the position (e.g., centrality) of individuals in the network. Results show a high degree of variation in contact rates across months and among individuals. Social predictors including age, rank, and relatedness significantly affect the likelihood that two individuals will interact, while age and rank significantly affect an individual's centrality in the network. Our next step is to simulate disease transmission dynamics by combining social network data with infectious disease models. Overall, this work represents a multi-disciplinary approach to understanding how primate behavior affects pathogen transmission. Our findings provide information needed to develop intervention strategies for protecting Africa's great apes in the event of a future epidemic.

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Biodiversity Foundation, and the US Fish and Wildlife Service.

A comparison of methods for studying elusive savanna chimpanzees at Ugalla, Tanzania.

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The difficulty of observing elusive savanna chimpanzees makes one's choice of methods decisive. Currently, three main methods are employed to study unhabituated chimpanzees at the site of Issa, Ugalla in western Tanzania: (1) "Listen and Follow", (2) digital camera traps, and (3) day-long patch vigils. This paper compares these methods over a one-year period to determine which approach results in the greatest number of chimpanzee and other unhabituated mammal sightings. "Listen and Follow" resulted in the highest chimpanzee encounter rate, followed by camera traps, with some cameras yielding more encounters than others; patch vigils had the lowest rate of chimpanzee sightings. However, the encounter rate of non-chimpanzee fauna was higher for patch vigils than for camera traps. Differences in encounter rates are likely due to biases in how these methods are employed: "Listen and Follow" is used in areas where chimpanzees are assumed to be based on previous sightings or vocalizations; camera traps are located throughout the study site, but placed near animal trails; patches are randomly selected, distributed in areas that may or may not be near trails or in locations known to be frequented by chimpanzees. Results indicate that a method such as "Listen and Follow" is more informative for a species-specific study, particularly at sites where researchers have an idea where animals are located, and are thus able to direct search efforts. Methods like camera traps and day-long patch vigils, although not commonly used for primatological research, are extremely informative and well suited for community ecology studies.

Is motherhood bad for oral health? Effects of parity on periodontal disease, caries and tooth loss in US women.

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The old wives' tale "for every child, the mother loses a tooth," is a pervasive belief in many cultures – that tooth loss is a natural consequence of childbearing. We hypothesized that increased parity was related to periodontitis and caries, and to increased tooth loss, through both biological and non-biological pathways. Using data collected from 2635 white and black non-Hispanic women age 18-64 years selected from the Third National Health and Nutrition Examination Survey, we tested an *a priori* theoretical model that specified that, controlling

for age, socioeconomic status and diabetes, parity is related to increased periodontal disease, caries and tooth loss, and that effects of parity are both direct (that is, biological) and indirect (non-biological, including dental care, psychosocial factors, and dental health damaging behaviors).

Path models indicated that increased parity was associated with tooth loss (robust $\beta=.12$), increased periodontal disease levels (robust $\beta=.07$), and untreated dental caries (robust $\beta=.08$) (all $p \leq 0.001$). The impact of parity on both tooth loss and on periodontal disease outweighed the effects of smoking, a major risk factor for both these conditions. Parity was unrelated to dental care, psychosocial factors or dental health damaging behaviors in this sample.

Parity is strongly related to dental diseases and to tooth loss in U.S. women, but the mechanisms remain undefined. Further investigations that include both women and men are needed to clarify the effects of sex/gender and parity on dental health.

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Internal bone structure of the last sacral vertebral body and its relationship to tail length.

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The distal sacrum is the tail's sole bony link to the rest of the body and is one of the best-preserved vertebral elements in the fossil record. Reconstructing tail loss in extinct primates depends on how sacral anatomy is associated with tail length in living primates. We employed high resolution X-ray computed tomography to analyze cortical and trabecular bone structure of the last sacral vertebra among macaque species that vary in relative tail length (RTL=tail length / head + body length), including *Macaca fascicularis* (RTL:107), *M. nemestrina* (RTL:37), and *M. tonkeana* (RTL:8). We analyzed dorsal (dROI) and ventral (vROI) vertebral body cortical shell regions of interest, and placed volumes of interest in the vertebral body's cranial (VOI-Cr) and caudal (VOI-Ca) ends. *M. fascicularis* had the thickest cortical bone and its mean values (dROI:245; vROI:252) clearly distinguished it from *M. nemestrina* (dROI:90; vROI:113) and *M. tonkeana* (dROI: 90, vROI:101), who exhibited similar mean values. VOI-Cr bone volume fraction was greatest in *M. fascicularis* (0.28), followed by *M. nemestrina* (0.17), and then *M. tonkeana* (0.11). VOI-Ca bone volume fraction was similar between *M. fascicularis* (0.33) and *M. nemestrina* (0.32), but both species exhibited higher values than *M. tonkeana* (0.21). Trabecular number in VOI-Cr and VOI-Ca was greatest in *M. fascicularis*, followed by *M. nemestrina*, and then *M. tonkeana*, but numbers correlate positively with body mass. VOI-Cr trabeculae were craniocaudally oriented in all species. VOI-Ca trabeculae were consistently craniocaudally oriented in *M. fascicularis* and *M. nemestrina*, but were more variably oriented in

M. tonkeana. The influence of sacrocaudal joint loading, tail musculature, and body size on the sacrum's internal bone structure is discussed.

Developing the brain: a potential role for the placenta in hominin brain evolution.

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Of all primates, humans produce the largest, fattest, most encephalized neonates, relative to maternal size. Possessing this unique suite of characteristics at birth suggests that the intrauterine supply of nutrients available to the developing fetus has increased or been made more efficiently available in hominids compared to other primates. We discuss three interrelated phenomena to explain how the prenatal environment changed for the hominins and how these changes created the required nutritional reservoir to grow big-brained babies, forming the developmental foundation for the encephalization that is the hallmark of human evolution. First, we examine postulated changes in body size and diet in the hominin lineage that changed gestational energetics. Next, we address the impact that significant locomotor changes might have had on gestation. This leads to a discussion of the role the placenta plays in supplying the fetus (and the fetal brain) with maternally derived nutrients and how changes in hominin placentation might have been a key underpinning of increases in brain size. We posit that the schema of hominin placentation coupled with dietary changes increased the intrauterine transport of nutrients and was necessary to build the developmental foundation for significant increases in brain mass during the last two million years of human evolution.

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Ontogenetic changes in cortical and trabecular bone in the human femur and tibia.

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During human ontogeny, the initiation and eventual adoption of obligate bipedalism parallels a significant increase in body mass. These events dramatically alter the loads

imposed on the lower limb skeleton throughout childhood and adolescence. The goal of this study is to examine the developmental trajectories of cortical and trabecular bone in the femur and tibia from birth to adulthood. High-resolution x-ray CT scans were collected for the femur and tibia of 70 individuals from the Norris Farms #36 skeletal collection ranging in age from neonate to adult. The entire bone was scanned with voxel dimensions less than 0.05mm. Cortical bone cross-sectional geometric properties were quantified at midshaft, and 3D trabecular bone structure was quantified for cubic volumes of interest extracted from the proximal femoral and tibial metaphyses. The results indicate that mid-diaphyseal cortical area (CA) and torsional and average bending strength (Z) follow broadly similar growth trajectories in the femur and tibia, continuing to increase until early adulthood. While the femoral midshaft remains primarily circular (I_{max}/I_{min}), the tibial midshaft becomes significantly more anteroposteriorly rigid during ontogeny. Trabecular structure displays a more complex pattern with most variables (BV/TV, Tb.Th, Tb.Sp, DA) following unique trajectories reflecting localized bone growth, (re)modeling processes, and joint kinematics that level off at adult values after approximately 10 years of age. These results indicate that while clearly interrelated, cortical and trabecular bone follows different growth trajectories in the femur and tibia, likely due to divergent biomechanical stimuli as well as different genetic mechanisms.

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Shape analysis of the palpebral fissure in humans.

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The shape of the palpebral fissure is relevant to medical research for various reasons. It may, for example, indicate Down syndrome (Trisomy 21) or fetal alcohol syndrome (FAS). For diagnostic purposes, it is common to measure the length of the palpebral fissure or to qualitatively describe its shape. Existing studies mainly involve images of persons with opened eyes.

This study evaluates a new approach to quantify palpebral fissure shape using the concept of crestlines and statistical shape analysis. By applying these methods, observer error is minimized because the crest line algorithm automatically detects points of highest curvature in a certain surface area while statistical shape analysis allows for a comprehensive interpretation of those configurations. 200 CT scans of Asian and European male and female individuals with closed eyes were used to determine whether there are significant shape differences depending on age, sex, and population affinity.

Recent trends in the use of human remains for anthropological research during international human rights investigations.

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This paper examines the use of human remains for anthropological research in the former Yugoslavia and Guatemala between 1996 and 2011. This paper surveys articles from the *Journal of Forensic Science* and the *American Journal of Physical Anthropology* in order to examine recent trends in the use of genocide and massacre victims remains for anthropological research and publication. Data was collected from the articles to assess the detail with which the conflicts were described, consent described in the acknowledgements for the use of the remains for research and publication, and the proposed end goal of the research including its perceived impact on survivors and identifications. While a majority of the articles discussed the conflicts to some degree, a minority mentioned "genocide" or "human rights abuses", and even fewer discussed the individual conflicts in detail. In cases where permission was noted for the use of human remains for research, permission was always given by overseeing organizations. None of the articles mentioned seeking family or survivor consent for the use of remains or antemortem data for research. Finally, this review found that a majority of studies were initiated to create population-based standards for constructing the biological profile in order to advance identifications. The goal of this research is to open a dialogue for ethical considerations for future research endeavors in international human rights investigations.

Strontium tells all at Tell Dothan: exploring migration with strontium isotope analysis.

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Strontium (⁸⁷Sr/⁸⁶Sr) isotope signatures from human enamel samples were compared to those of archaeological fauna from Tell Dothan in the southern Levant to track mobility during the Late Bronze (1550-1200 BCE) and Early Iron (1200-900 BCE) Ages. This study predicted a high incidence of migration spanning both periods due to the city's geohistorical context. Located near a major trade route, Tell Dothan was likely influenced by an influx of immigrants who may have been interred in local tombs. Human dental enamel (LM¹; n=20) was utilized to expand on a previous study (LM²; n=24) of the same commingled collection. A subsample (n=5) of *in situ* first and third molars was also tested to evaluate temporal shifts in mobility within the lifetime of single individuals.

A local range of 0.70817±0.00017 (2σ) was established for Tell Dothan using archaeological faunal enamel (n=4). Only one individual sampled (0.70766) fell outside this range. A general comparison of ⁸⁷Sr/⁸⁶Sr ratios between all isolated first (0.70815±0.00006, 1σ) and third (0.70812±0.00010, 1σ) molars showed no significant difference (Mann-Whitney U test,

$p=0.44$). Additionally, no significant change in $^{87}\text{Sr}/^{86}\text{Sr}$ value was detected between the *in situ* first and third molars ($p=0.75$). These comparisons indicate that most people buried at Tell Dothan were of local origin and spent their childhood and early adult life at the site. While texts describe Tell Dothan as a trading hub, immigrants in general were not buried locally.

This research was supported by the National Science Foundation-Research Experiences for Undergraduates (SES #1005158) Summer Research in Bioarchaeology Program at the University of Notre Dame.

Contributions of phenetic relationship and stable isotope analysis ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{18}\text{O}$) to the study of a mortality crisis in the catacomb of Saints Peter and Marcellinus in Rome (1st-3rd century AD).

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The catacomb of Saints Peter and Marcellinus located in the south-east of Rome approximately contains 25 000 graves dated from the 3rd to the 5th century AD. Seven newly discovered rooms having an unusual organization in the heart of the catacomb were investigated in 2003. Excavations of these rooms revealed a mass grave, where 3 000 corpses were laid together. These individuals were stacked in rows apparently following a common fatal incident. Presumably, this epidemic crisis occurred between the 1st and the 3rd century AD. The specific funerary treatment (textile wrapping and plaster) recalls mummification and might be related to exogenous practices, possibly connected to Early Christians. Moreover, the presence of rare and expensive materials (e.g., Baltic amber, resins and gold threads) may indicate a high social status. Stable isotope analyses (carbon, nitrogen and oxygen) of bone collagen, bone apatite and tooth hydroxyapatite were carried out on 111 individuals to obtain further information on their diet and residential mobility. Additionally, a study of dental nonmetric traits was conducted on 200 individuals to define the biological distance between the deceased and to assess their phenetic similarity. The combination of these two approaches will bring new insight into the homogeneity of the Early population of the catacomb of Saints Peter and Marcellinus and the relationship between funerary practices and geographical origin of buried individuals.

Individual distinctiveness in wild western gorilla (*Gorilla gorilla*) vocalizations.

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Individually distinct vocalizations play an important role in animal communication, allowing call recipients to respond differentially based on caller identity. However, which of the many calls in a species' repertoire should be individually recognizable is less apparent. One proposed explanation is that calls used over long distances (long calls) should be more individually distinct than close calls because visual cues are not available to identify the caller. An alternative explanation, based on function, proposes that close calls should be more recognizable because of their importance in social interactions. To examine this question we determine which of nine wild western gorilla calls, given over varying distances and used in differing contexts, were individually distinct. We recorded 2096 calls from 10 individual gorillas during focal follows conducted over 18 months at the Mondika Research Center, Republic of Congo. Acoustic analysis of calls yielded 20 acoustic parameters and we used discriminant function analysis of these parameters to test the proportion of calls that could be correctly assigned to their caller. Results indicated that all nine calls, including both long and close calls were individually distinct, although to varying degrees. Long calls (i.e., screams and long contact calls) and some common close calls (i.e., grunts, grumbles and hums) were highly individually distinct, whereas two other close calls, both used in a single context (i.e., mating and aggression), were less individually distinct. Therefore, both distance and function may have played a role in the evolution of call individuality in gorillas.

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Natural selection and celiac disease.

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Celiac disease (CD) is a common, highly heritable (Nistico et al. 2006) small intestinal inflammatory condition induced by wheat gluten and related proteins from rye and barley (Sollid 2000). When left untreated, the clinical presentation of CD can include failure to thrive, malnutrition, and distension in juveniles. These symptoms are referred to as the tip of the "celiac disease iceberg," as the disease can additionally lead to severe vitamin deficiencies, anemia, and osteoporosis (Barker and Liu 2008). Therefore, CD potentially had a negative effect on fitness in past populations utilizing wheat agriculture.

To date, three studies have addressed the question of natural selection in CD (Barreiro et al. 2009; Soranzo et al. 2009; Zhernakova et al. 2010). Results from these studies indicate that at least some genetic loci associated with CD risk have undergone recent positive selection. These

studies also suggest the possibility that risk for common autoimmune conditions such as CD may be the result of past positive selection on immune related loci in the genome to fight infection. Under this evolutionary scenario, disease phenotypes may be a trade-off from positive selection on immunity. If true, a signal of natural selection across the CD risk network is expected. The current study represents the first complete analysis of natural selection on risk loci for CD from the Catalogue of Genome Wide Association Studies. Results from linkage based selection tests on individual risk loci and the complete set of risk loci as a functionally-related network are reported.

Intra-tooth stable isotope analysis of human dental tissues: laser ablation of enamel and serial sections of dentine collagen in permanent first molars and canines.

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Time series stable isotope analysis in dental tissues has become a useful tool for investigating diet histories in a variety of modern and fossil animals, but has only recently been applied to humans in archaeological contexts. The permanent human dentition preserves chronological dietary information for approximately the first two decades of life, as enamel and dentine do not turn over once fully mineralized. A time interval of particular interest to anthropologists is that which captures the weaning process, as the timing and nature of this life history event have crucial ramifications for a number of important demographic variables; however, conventional methodologies have lacked the resolution to describe these events in much detail. Methodological advances in laser ablation isotope analysis have made it possible to measure carbon and oxygen isotope ratios *in-situ* with tremendous spatial precision providing an opportunity to greatly refine chronological isotopic profiles in human enamel. New methods for incremental sampling of human dentine collagen have been developed that greatly improve the resolution of carbon and nitrogen isotope chronologies within this tissue as well.

In this study, we combined these techniques for the first time to compare isotope sequences in enamel and dentine collagen of permanent first molars and canines from five individuals from Kulubnarti, an Early Christian site in Sudanese Nubia (500-800 A.D.). The results indicate that both methods reveal considerable isotopic variability within teeth and among individuals, produce comparable patterning, and hold promise for reconstructing human dietary and life histories for archaeological and paleontological applications.

This study was funded by a Dissertation Fieldwork Grant, The Wenner-Gren Foundation.

Are big primates less hairy? Primate hair and body size revisited.

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Humans are unique among primates in our apparent hairlessness. Schwartz and Rosenblum (1981, *AJPA* 55: 9-12) investigated the role of body size on anthropoid hair density. They found that as body surface area increased, "relative hair density" (RHD: hairs/cm²/body surface area) decreased. They concluded that larger anthropoids have systematically less dense hair due to thermoregulatory adaptations. This hair pattern may result simply from differences in growth. In humans, the absolute number of hair follicles appears to be determined in utero: increases in surface area postnatally decrease the density of hair follicles. If a similar pattern of follicle formation occurs in all primates, I hypothesize that larger primates exhibit lower hair follicle densities than smaller primates due to increasing body surface area. Therefore, I plotted body mass (g) against hair density (hairs/cm²) in 22 anthropoids using data from the literature. The RHD variable obscures the physiological significance of hair density and makes a scaling relationship less intuitive, as RHD is a count/cm²/cm² regressed against surface area (cm²). Consistent with Schwartz and Rosenblum, I found negative relationships between body mass and scalp, chest and back hair density. Body mass, however, explains only 50-60% of variance. RHD regressed against body surface area appears to have created a specious relationship between hair density and body size. Further study of the morphology and ontogeny of hair will elucidate the size-density relationship, and provide insights into the human hair phenotype and the function of hair in primate evolution.

Mobility and dietary composition in Quillagua (northern Chile) during the Late Intermediate Period (AD 1000-1400).

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Quillagua is a small oasis located at the margins of the Loa River in northern Chile, 70 km from the Pacific coast. It has been intensively occupied since the Late Formative Period and archaeological research in the area has recovered evidence of significant cultural heterogeneity in Late Intermediate Period (AD 1000-1400) funerary contexts. This heterogeneity has been interpreted as a result of the direct influence of two different cultures in the oasis: the Tarapacá culture, which originates on the coast north of Quillagua; and the Atacameño culture, present in highland areas southeast of Quillagua. Here, we present the results of carbon, nitrogen and oxygen stable isotope analyses of 23 individuals recovered from Quillagua's Cementerio Oriente (Eastern Cemetery). Our objective was to test whether the observed cultural heterogeneity was

reflected in aspects of local diet and mobility patterns. Results from carbon and nitrogen isotopes show that there was an important consumption of marine proteins in the majority of individuals, with some also showing high C4 plant consumption (maize). Oxygen isotope results show very low ¹⁸O values for four individuals in the sample, which is suggestive of a possible highland origin, while the remaining individuals show ¹⁸O values consistent with coastal origins. Together, these results favor the idea that the Quillagua oasis represented an important interaction area, with close contact with the coastal environment and a significant presence of people from the interior.

Comparison of the enthesal changes in the hip bone of Portuguese males (19th-20th centuries) with known occupations.

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This study aim to assess if occupation influences the appearance of enthesal changes in the iliac crest, retroauricular area, ischiatic tuberosity and *obturator foramen*. Absence or presence of osteophytic and osteolytic lesions was recorded in both hip bones from 130 males (19 to 88 years old) from Lisboa and Coimbra identified skeletal collections.

According to the occupations recorded the individuals were divided in two groups: manual (n = 69) and nonmanual (n = 61). The sample was also divided according to an osteological indicator, the femur robusticity index (50 are robust and 59 are gracile femurs). The individuals from manual and robust groups were considered with physically demanding occupations while the nonmanual and gracile groups represent cases with less demanding activities. The asymmetry and the influence of occupational activities of the enthesal changes were inferred by chi-square test. Osteophytic and osteolytic lesions have no asymmetry when considered both bones from the same individual (p < 0.05). The osteophytic lesions in the four areas observed and the osteolytic lesions of the ischial tuberosity do not appear to have been influenced by occupational activity (p > 0.05). For the other osteolytic lesions was impossible to assess the influence of occupational activity because: 1) in the iliac crest the osteolytic lesions (n=2) occurs only in the nonmanual and gracile individuals; 2) they are absent in the retroauricular area, iliac tuberosity and *obturator foramen*.

In this sample, the occupational activity does not seem to influence the development of enthesal changes in the hip bone.

A major migration followed by recurrent gene flow as a model for the peopling of Americas: a patrilineal perspective.

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A model suggesting a single major migration during the pre-Columbian peopling of Americas has been described by geneticists working with Y chromosome and mtDNA markers in the middle 1990's. Subsequent genetic analysis reinforced this model, but also indicated that some minor lineages did not fit the single migration expectations, and in 2008, a consensus model has been proposed by our group (González-José et al. *AJPA* 2008), reconciling all available genetic and morphological data. This consensus model claims that most of genomic background of present native Americans would be derived from a major migration occupying Beringia in the end of Pleistocene that expanded to colonize Americas, but new alleles and phenotypes were brought from Asia through recurrent gene flow during Holocene. We present here new genetic evidence indicating that this scenario is the most compatible with the current distribution of paternal lineages detected by the Y chromosome phylogeny. New data of previously cryptic Q and C derived haplotypes were now detected with a higher number of SNPs in a large native American sample and indicate a minor but heterogeneous diversity of Y lineages, which map their separate origins in Asia and it is an expectation a low gene flow that could also bring the Mongoloid morphology traces to Americas.

This study was funded by FAPEMIG, CNPq, CAPES and National Geographic Society.

Insect prey characteristics affecting regional variation in chimpanzee tool use.

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Much has been claimed about regional variations in chimpanzee tool use, with little attention to the ecological circumstances which may have shaped such differences. To address this issue, we conducted a systematic comparison of chimpanzee tool use and termite prey between the Goualougo Triangle in the Republic of Congo and the La Belgique research site in southeast Cameroon. Apes at both of these sites are known to use tool sets to gather several species of termites. We collected insect specimens and measured the characteristics of their nests. Associated chimpanzee tool assemblages were documented at both sites, and video recordings conducted in the Goualougo Triangle. Although Macrotermitinae

assemblages were identical, we found differences in the tools used to gather these termites. Based on measurements of the chimpanzee tools and termite nests at each site, we concluded that some characteristics of chimpanzee tools were directly related to termite nest structure. However, chimpanzees of the Goulougo Triangle used different tool sets to gather *M. muelleri* and *M. lilljeborgi*, whereas the same tool sets were used for both species at La Belgique. Our conclusion is that some of the regional variation in chimpanzee technology is due to microecological differences, whereas other aspects are likely related to social influences.

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The hominin heel process and the human lateral plantar tubercle.

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Thirty years ago at AAPA meetings in Oregon, Sarmiento showed the heel process was common to climbing mammals and associated with tarsal attachment for short toe flexors m. With a tarsal attachment, short flexor contribution to pedal grip is not compromised by talo-crural and subtalar joint position. The modern human heel process has been further modified for bipedal weight support serving as a proximal anchor for longitudinal arch. Osseous ligamentous and muscular relationships seen in human and great ape foot dissections corroborate Weidenreich's (1940) contention that the great ape peroneal trochlea is the homologue of a human lateral plantar tubercle that migrated plantarward and proximally to abut the tuber calcanei. The human lateral plantar tubercle gives attachment to lateral plantar ligament and when present to ossi metatarsi quinti m. The latter muscle was present in all eastern gorillas (n=5) but is variable or rare in other great apes. The human lateral plantar tubercle position affords the ossi metatarsi quinti m. and its likely homologue the lateral plantar ligament an advantageous moment arm for supporting the longitudinal arch. Hominin fossil calcanei spanning the last 3.4 Ma fail to show a fully migrated lateral plantar tubercle indicating this feature is a recent human acquisition. Relative to modern humans more laterally positioned tubercles in hominin fossils suggests the muscle/ligament prevent(s) forefoot dorsiflexion in more medially rotated positions of forefoot relative to calcaneus, while a more proximal position of the tubercle indicates both muscle and ligament were less powerful in doing so.

Climatic effects on wild ring-tailed lemur biomedical values at the Beza Mahafaly Special Reserve, Madagascar.

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Placing wild primate biomedical values within an ecological context is essential for understanding how environmental perturbations affect health, and is important for developing both sound conservation policies and relevant information for good captive husbandry. We report values across a six-year period (2005-2010) for a wild population of ring-tailed lemurs at the Beza Mahafaly Special Reserve, Madagascar. Body weights, skin fold measurements, percentage hematocrits, white and red blood cell counts, serum protein and differentials (neutrophils, lymphocytes, monocytes and eosinophils) for wild lemurs (n = 39-69 individuals per year, depending on measure) are compared by year and annual wet season rainfall. Results indicate a major destructive cyclone in 2005 that caused a reduction or failure of key foods during the birth season and early lactation period of 2005, followed by a drought in 2006, had significant impacts on biomedical values. Body weights (p<.001), white blood cell counts (p<.004), and skin fold measurements (as a measure of body fat; p<.01) reached a six-year low for most age classes. Differentials such as neutrophils and lymphocytes were also affected, with statistically significant lower neutrophil counts among adults and subadults, lower counts in subadults relative to adults, and lower counts in adult males versus females. Monocytes also reached a six-year low (p<.001). These changes in biomedical measures appear related to stress, driven by a period of nutritional challenge in the aftermath of major cyclone damage, and provide strong support that stochastic climatic events can have dramatic impacts on wild primate physiological measures.

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The chimpanzee is not a valid behavioral model for *Ardipithecus ramidus*.

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Few hominoids have ever differed as greatly as do living chimpanzees and *Ardipithecus ramidus*. While similar in cranial capacity, the two taxa contrast markedly in almost every major aspect of their dentitions and postcrania. In living forms, these characters are

known to directly relate to the niche an animal can or does occupy. We utilize these data and evolutionary ecology to explore divergence in chimpanzee and *A. ramidus* foraging and reproductive strategies.

Broad research has identified variables critical for predicting diet and social system. For the former, these include food energy, handling time, and encounter rate. *A. ramidus* is characterized by a more generalized dentition than chimpanzees, lacking both large incisors and increased molar shearing surfaces. These suggest important contrasts in abilities to process and extract energy from particular foods. *A. ramidus* locomotor characters present an even greater contrast. Associated differences in handling time/costs likely resulted in divergent foraging strategies, particularly regarding putative predatory behavior. In relation to reproduction, the combination of low skeletal dimorphism and lack of a functional canine/premolar complex in *A. ramidus* indicates a social system unlike any extant great ape.

Our argument is not that chimpanzees are irrelevant to human evolution, or that we should replace this primate with another referential model. We instead propose that broad studies of living primates, including but not limited to chimpanzees, should focus on identifying variables most important to ecology and behavior, and that these variables should be reconstructed specifically for early hominids based on their unique anatomy and habitat.

Male resource defense in Argentine tufted capuchin monkeys (*Cebus apella nigritus*): consequences for intergroup dominance relationships and home range quality.

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Recently, it has been suggested that between-group contest competition and male resource defense have been underestimated in nonhuman primates. In many species, food resources within the group's core area may depend on the resource holding potential of resident males. Among Argentine tufted capuchin monkeys (*Cebus apella nigritus*), dominant and subordinate males cooperate to defend immediate access to high-quality food resources. Here I investigate consequences of this male-male cooperation for intergroup dominance relationships and home range quality. I recorded ranging behavior for four habituated groups in Iguazú National Park for 16 months to identify home ranges and core areas. I measured the availability of food species within botanical plots placed in each group's core area, using a stratified random sampling. I recorded the location and outcome of intergroup encounters, and performed generalized-linear mixed models to assess the relative importance of male group size and encounter location on the outcome. Relative male group size was the most important factor in determining the winner of encounters, outweighing the competitive advantage of ownership. Average core area size was positively correlated with male group size, but neither the density of food species nor the total availability of food resources within the core area was influenced by the group's competitive ability.

Dominant groups are better able to defend their core area, however, and adjusting for the degree of home range overlap revealed that dominant groups may have higher *per capita* access to food. These results suggest that male-male cooperation could ultimately increase female reproductive success.

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Radiogenic strontium isotope analysis from the Hopewell affiliated Brown's Bottom site and baseline data for the central Scioto River Valley, OH.

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Radiogenic strontium isotope and elemental concentration analyses of archaeological faunal and human remains from two Hopewell affiliated sites were undertaken. The faunal remains from Brown's Bottom and McGraw were analyzed to determine a bioavailable $^{87}\text{Sr}/^{86}\text{Sr}$ baseline range for the central Scioto River Valley of Ohio. The $^{87}\text{Sr}/^{86}\text{Sr}$ values of two human individuals interred at Brown's Bottom were determined to assess paleomobility. These individuals are unusual because they were buried at a domestic, rather than a ceremonial, site. The faunal samples from Brown's Bottom ($n=7$) were composed of deer (*Odocoileus virginianus*), and one beaver (*Castor canadensis*). The faunal samples from McGraw ($n=8$) were also primarily deer, with one dog (*Canis lupus*) and one raccoon (*Procyon lotor*).

The results of the elemental analysis did not indicate that diagenetic processes had affected the samples. The "local" radiogenic strontium isotope ratio for each site is identified through the use of archaeological faunal samples, and the "local" range for the Brown's Bottom fauna is $^{87}\text{Sr}/^{86}\text{Sr}=0.703-0.723$ and for McGraw fauna is $^{87}\text{Sr}/^{86}\text{Sr}=0.705-0.716$. These baseline data have a sizeable range, which is hypothesized to result from the hunting and/or migration patterns of deer. The three other mammal samples have a different average and smaller standard deviation ($\bar{x}=0.709$; $\sigma=0.0002$; $n=3$) than the deer samples ($\bar{x}=0.713$; $\sigma=0.004$; $n=12$) and possibly reflect conditions immediately around the two sites. The values for both human individuals buried at Brown's Bottom are $^{87}\text{Sr}/^{86}\text{Sr}=0.71013$ and $^{87}\text{Sr}/^{86}\text{Sr}=0.70992$. Based on these data the human individuals cannot be classified as "non-local".

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Using GIS for paleoecological reconstructions: a case study from Laetoli, Tanzania.

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The Pliocene site of Laetoli in northern Tanzania has produced a large and varied faunal assemblage, including specimens of *Australopithecus afarensis*. In contrast with most contemporary East African hominin sites, the depositional environment of the Upper Laetoli Beds (~3.5-3.8 Ma) is unique due to a lack of evidence of permanent large bodies of water. Thus, a deeper understanding of the paleoecology of Pliocene Laetoli may be illuminating with regard to questions of habitat access, use, and preference of *A. afarensis*. Attempts to reconstruct the paleoenvironment of the site, however, have yielded a wide variety of interpretations regarding habitat composition. These differing reconstructions may partly be due to the coarse resolution of the available data. The use of Geographic Information Systems (GIS) technology has not been fully explored in paleoecological analyses, but has great potential in helping to resolve these issues. GIS analysis was conducted on various paleoenvironmental indicators from the Upper Laetoli Beds, including faunal indicator species, stable oxygen and carbon isotopes, and geologic data. These analyses support previous evidence of habitat heterogeneity at Laetoli, suggesting that central areas of the site principally consist of mixed habitat including grassland, bushland, woodland, and some wet areas. Indicators also suggest less heterogeneous habitat types near the margins of the site, with perimeter localities mapping as predominantly wooded or open. This novel use of GIS allowed for better visualization of geographic and temporal relationships among the paleoenvironmental indicators and provided greater resolution when considering questions of habitat composition and distribution during Pliocene Laetoli.

Anthropological usefulness of forensically useful ancestry (AIM) and phenotype informative markers (PIM).

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As part of a study of 96 SNPs (53 PIM, 43 AIMs) funded by NIJ to identify eye, hair and skin color and geographic origin the question arose as the anthropological usefulness of these markers.

SNPs were tested in a series of multiplexes using SnapShot® technology on 276 samples with phenotype and ancestry data, 175 individuals with self-identified ancestry, 2783 samples from ALFRED and 1,206 HapMap samples. Complete data was available for African, European, Indian, East Asian, Native American and US Hispanic populations for the AIMs, while Africa, East Asia, European, Indian and Hispanic data was available for PIMs. Though 53 PIM SNPs were tested 2 were monomorphic. Data sets were reduced using Principle Components Analysis and

hierarchically clustered using Wards method on a Squared Euclidean distance matrix. Because kits would use a restricted set of SNPs, PCA and cluster analysis were repeated with a subset of 23 AIM and 15 SNPs, with variables chosen by their highest factor loadings.

Results using AIM SNPs yielded a 43 SNP tree that was accurate for Africa, Europe and India but had some problems with East Asia, Native Americans and Hispanics, while the 23 AIM SNP tree accurately classified all populations. In contrast the 51 and 15 SNP PIM trees cluster all non-European populations as separate from Europeans.

Based on the results of this study PIM SNPs present a totally different view of modern human differentiation and may be useful in asking different questions than those traditionally posed regarding human populations.

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An interdisciplinary genomic approach to the study of adaptation and population histories in Sub-Saharan Africa.

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The earliest genetic studies reported in Africa focus on single genes or single loci; however, the recent emergence of high-throughput genetic methodologies provides an opportunity to study past population histories with a more comprehensive picture of genetic variation. To this end, several studies have begun to integrate African genetic and genomic data with archaeological and linguistic data and have reported a general pattern in which geographic distance, linguistic affiliation, and genetic variation are often correlated. There are, however, cases where this correlation does not hold, including the example of the Fulbe (also known as Fulani, Fula) peoples living in western and central Africa. Here we present work on two Fulbe populations living in Cameroon and Nigeria and contextualize it with previously published data. We highlight the challenge of reconstructing Fulbe population history given the large size (>10 million) and broad geographic distribution of this ethno-linguistic group. The preliminary genetic data support a model of complex Fulbe population history including past gene flow with populations living throughout western, central and northern Africa as well as with Eurasians. Future work that includes refined demographic scenarios generated from archaeological, linguistic, and historical data combined with an expanded set of population samples will help refine our understanding of past population movements and interactions in Africa.

Comparison of the humeral cancellous bone in Neolithic human populations and present day people.

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Bone is a plastic material. Like a functional signature, it stores information about its loading history. Recent studies about the functional adaptation of bone indicate that use over time has a stronger impact on bone structure than genetic predisposition. Cancellous bone has a higher annual turn-over rate than cortical bone and therefore is very sensitive to its daily loading regime.

Here we test the hypothesis that the cancellous bone architecture of the humerus involves fine-tuned information about loading regimes and is able therefore to differentiate between different habitual manual activities. For this purpose we compared the trabecular architecture of the humeral head in samples from Neolithic human populations from Germany to that of a sample of contemporary Germans. The specimens were scanned at 130 kV and 100-110 μ A with a GE v|tome|x s CT system at the University of Tübingen Computed Tomography Laboratory and with a BIR ACTIS 225/300 CT system at the Max Planck Institute for Evolutionary Anthropology in Leipzig. Using these high-resolution scans of proximal humeri, we quantified the global trabecular architectures, measuring nine standard 3D-morphometric parameters. Principle component analysis of the 3D-morphometrics of the trabecular architectures separated the population samples, pointing out differences in the gross trabecular architecture, likely reflecting differences in the manual working routine between the sampled populations.

The results of this project provide a basis for assessing activity levels and subsistence techniques in past populations. Their application to the fossil record holds substantial promise for the interpretation of such behaviors in extinct hominins.

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Epaxial muscle function in walking and running humans.

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During locomotion, human epaxial muscles have been suggested to 1) dynamically stabilize the trunk in the frontal and sagittal planes during walking, 2) primarily control trunk motions in the sagittal plane during running, and 3) mobilize the trunk in the sagittal and transverse planes during walking. In this study, we tested an additional hypothesis. We hypothesized that the human epaxial muscles of humans also function to dynamically stabilize the pelvic girdle against the action of the extrinsic limb muscles and thus provide a firm base for their activity during locomotion. To test this, we manipulated the locomotor forces acting on the trunk and the limbs by having subjects walk and run at three different speeds and inclinations and measured the activity of two epaxial muscles, the m. longissimus thoracis and the m. multifidus lumborum, and six extrinsic limb muscles in seventeen healthy male subjects. Additionally, we recorded the activity of five intrinsic limb muscles to assess whether the epaxial muscles also function in the vertical support of the body. Using correlation analysis, we tested if the changes in the activation patterns of the extrinsic and intrinsic limb muscles associated with changes in gait, speed or inclination were met by corresponding changes in the activation patterns of the ipsilateral and/or the contralateral epaxial muscles. Our results are consistent with the human epaxial muscles providing dynamic stability of the pelvis against the actions of the contralateral retractor and the ipsilateral protractor muscles as well as providing vertical support of the body.

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Sliding semi-landmarks on symmetric structures in three dimensions.

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Analysing the symmetry/asymmetry of biological structures has entered the morphometric toolbox more than a decade ago. It allows the quantification and evaluation of directional and fluctuating asymmetry. Additionally, the application of semi-landmarks makes geometric analysis of structures possible where homologous landmarks can only be placed very sparsely. But how can both methods be combined and what has to be thought of beforehand? Usually semi-landmarks are placed semi-automatically by estimating the positions on the target surface through projection from a reference configuration. The implications for asymmetry are quite clear: All configurations will show asymmetry inferred both by asymmetry biologically inherent in the reference and asymmetry caused by manual definition of the semi-landmarks on the reference's surface. To circumvent this problem, a regularisation is needed. This can be achieved by using sliding semi-landmarks that are relaxed against a symmetrised average. The results are configurations containing semi-landmarks unbiased by their initial reference and "as

symmetric as possible". To test the effects of this method, the amount of directional and fluctuating asymmetry are estimated from the sample containing only "real" landmarks and then compared to the results of tests containing semi-landmarks both relaxed against the ordinary sample's average and a symmetrised one: While our method and the classical one showed only mild signs of directional asymmetry, the one using non-regularised semi-landmarks, showed strong directional asymmetry, resembling the asymmetry found in the reference configuration.

Fighting back: how solitary and social insects have responded to attacks by insectivores and overwhelmingly powerful predators.

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Scale matters in the realm of predator and prey. For insectivorous primates including hominids individual insect prey are typically 4-7 orders of magnitude smaller than the predator. This discrepancy creates special problems for both: a single or small number of prey may not be nutritionally profitable for the predator; for the prey little possibility of direct active defense against the predators exists. Stinging insects (bees, wasps, ants) evolved a means to alter this imbalance of scale – the stinger and venom. This adaptation initiated a flurry of evolutionary interactions between insects and insectivores including man. I hypothesize that the sting enabled the evolution of higher sociality in Hymenoptera and that the increased nutritional mass of a social insect colony stimulated the evolution of specialist predators and behaviors to overcome the defensive sting. Evidence supporting the evolution of ever more effective (painful and toxic) stings as colony size in insect species increases is presented for over a hundred species. Physiological adaptations in horned lizards, ant specialists, have rendered them essentially immune to stings of their prey. Ratsels, some birds, and a variety of insectivores evolved protective coats and behavioral strategies to overcome the defenses of honeybees. Apes and humans have no elucidated innate physiological adaptations for defense against stinging honeybees, instead developed behavioral strategies. Humans with intelligence, learning, memory, and culture have not only won the defensive race with honeybees, but have during the last 150 years through artificial selection enslaved them as our agricultural servants and as a food source.

These investigations have been supported by Southwestern Biological Institute.

Modeling hominin swing phase mechanics using humans, chimpanzees, and other primates.

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Studies designed to infer limb posture during bipedalism of early hominins must often rely on a "bracketing" approach using multiple

models including humans and nonhuman primates adopting natural and induced gaits. We use such an approach to address a relatively novel issue in hominin locomotion: the biomechanics of swing phase. Most previous studies have focused on support phase where loads and muscular effort are the highest. But animals also use muscles to control the swinging limb, which has an impact on energetic costs and may constrain animal velocity. Previous studies have suggested that, with increasing velocity, support time decreases while swing time remains invariant. However, it is not known if this is true for all bipeds. Nor is it known how swing time varies by species or, since flexion of the swinging limb changes its pendulum length, how swing time changes with limb posture. We examined swing time in bipedally walking chimps and humans walking normally and with a bent-hip, bent-knee gait. Chimps and humans both showed significant decreases in support time with speed and no decreases in swing time, suggesting that swing phase time is constrained and that swing phase mechanics is an important factor influencing limb design. There were no significant differences in swing time between normal and bent-hip, bent-knee walking in humans. Compared to humans, chimpanzees devoted a relatively shorter time to swing phase. Our animal models suggest that attention should be paid to swing phase mechanics when reconstructing locomotor behavior and energetic costs in fossil animals.

Diets of early hominins: alternative hypotheses for the isotope data.

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Stable carbon isotope ratios in tooth enamel of early hominins from 5 sites across Africa suggest they fed on some amount of C4-based foods. Estimates fall between 30% and 50% C4-based foods for *Australopithecus africanus*, *Paranthropus* and early *Homo sp.* and close to 80% for *Australopithecus boisei* (Lee-Thorp and Sponheimer 2006 Yrbk. Phys. Anthropol. 49:131-148; van der Merwe et al. 2008 S. Afr. J. Sci. 104:153-155). The percent of C4-based foods is calculated by comparing the hominin data with endpoints defined by data from fossil browsers (C3) and grazers (C4).

The stable carbon isotope ratios in diet can also be estimated using the offset between the ratio in diet and tooth enamel. Our group's meta-analysis of data from laboratory animals with digestive physiologies similar to our own shows an offset around 10‰. The value is 14‰ in large bodied experimental (Passey et al. 2005 JAS 32: 1459-1470) and free-ranging East African fauna (Cerling et al., 2003 J. Mammalogy 84: 456-470) that rely on extensive fermentation for energy extraction. Using 14‰ the diets of early hominins would be 100% C3-based foods with the exception of *Australopithecus boisei*. Our new analysis of free-ranging fauna and the earlier meta-analysis also imply differences in offsets when feeding on C3- versus C4-based

diets. We propose that early *Homo sp.* ate some C4-based foods assuming digestive physiologies similar to our own, *Australopithecus boisei* relied largely on C4-based foods irrespective of digestive physiology, and the other early hominins, employing extensive fermentation, ate a largely C3-based diet.

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Activity patterns in New Kingdom, Third Intermediate, and Napatan Nubia: a diachronic study of osteoarthritis and enthesal remodeling at Tombos.

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The Egyptian Empire is well known for conquering Nubia and Syro-Palestine, marking the emergence of the New Kingdom period (1,550-1,069 BC). However, much less is known about the Empire's decline and the subsequent Third Intermediate (3IP) and Napatan periods (1,069-664 BC). During this time, unstable political conditions and internal fragmentation led to foreign invasion and subjugation by the Libyans (22nd-24th Dynasties; 945-715 BC) as well as the Nubians (25th Dynasty; 747-656 BC). Over the course of the 3IP Nubians regained sociopolitical power and formed the foundation of the powerful Napatan state, Kush, which would later conquer Egypt. However, the lifeways of local Nubians who contributed to and shaped Kush remain unclear.

Osteological indicators of physically stressful activity, specifically, osteoarthritis and enthesal remodeling, speak to the general nature of manual labor and types of physical activities in which local Nubians were participating. This bioarchaeological examination was performed on skeletal remains from the archaeological site of Tombos, located at the Third Cataract of the Nile. Tombos is one of few Nubian sites that were continuously occupied from the New Kingdom through the Napatan period, making it both unique and ideal for understanding changes in physical activity with sociopolitical change. The diachronic examination of activity patterns at Tombos reflects an increase in both frequency and severity of osteoarthritis and enthesal remodeling. This suggests that while Kush was gaining power, local Nubians performed more physically demanding manual labor in contrast with the less strenuous administrative activities of the prior New Kingdom period at Tombos.

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Sex-typing in juvenile male and female ring-tailed lemurs.

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Among mammals, primates have the longest juvenile periods relative to body size. Extended juvenility entails delayed reproduction and an increased chance of dying before

reproductive age. To account for its evolution, the protracted juvenile period must provide a significant fitness benefit over the course of an individual's lifespan. The sex-typing hypothesis proposes that extended juvenility allows for selective attention toward same-sex adults.

We test this hypothesis in a group of ring-tailed lemurs (*Lemur catta*) at the Duke Lemur Center consisting of three juveniles (two females, one male) and three adults (two females, one male). We predict that juveniles will spend more time grooming and as nearest neighbor to same-sex adults than opposite-sex juveniles will. From October 2010 through June 2011 we conducted scan sampling at 2-minute intervals, recording the activity and nearest neighbor of each juvenile and adult.

While the juvenile females did spend more time as nearest neighbor to adult females than the juvenile male did, this difference was not significant. Excluding the juveniles' mothers, the juvenile females spent equal amounts of time in closest proximity to the other adult female and the adult male (their father). The juvenile male, however, spent significantly more time as nearest neighbor to the adult male than either of the juvenile females did. There were no sex-based differences in the percentage of time that juveniles groomed with adults. These results suggest that the juvenile period may be especially important in that it provides time for juvenile males to associate with adult males.

Mandibular variation in early *Homo* and *Au. sediba*.

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The composition of the enigmatic early *Homo* hypodigm has been a central topic in the paleoanthropological literature for more than 50 years. Recently, the expansion of early *Homo* fossil samples and the announcement of new contemporaneous species have added to an ever intensifying debate surrounding the phylogenetic relationships among early members of our genus, renewing the idea of a diverse lineage, morphologically, temporally and geographically. The boundaries between specimens, populations and species have been further blurred with the new finding of *Au. sediba*, given the mosaic of *Homo*-like and *Australopithecus*-like traits displayed amongst the adult and juvenile individuals of this species.

Here we evaluate morphological diversity in early *Homo* and *Au. sediba* mandibular specimens, paying particular attention to the evolutionary positioning of the latter. Three-dimensional scanner and conventional morphometric data are collected from specimens from southern and eastern Africa, including an extant ontogenetic sample for investigation of variation between juveniles and adults of the same species. To provide context, numerous robust and gracile australopithecine mandibles are incorporated due to their temporal and spatial correspondence. Variance/covariance matrices from extant hominoids are used to calculate inter-individual scaled Mahalanobis' Distances

between these specimens to assess morphological relationships. EDMA is performed on mean forms of each sample and a series of PCoord analyses is used to visualize differences between juvenile and adult individuals (i.e., species growth trajectories). Results highlight a possible separation of east and South African early *Homo* specimens, and a unique growth trajectory for *Au. sediba*, neither australopith-like nor *Homo*-like.

Energy expenditure in semi free-ranging chimpanzees measured using doubly labeled water.

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Energy expenditure in mammals varies with body size but has not been measured systematically in primates. Orangutans show remarkably low energy throughput, a strategy that may reflect a species-specific adaptation to food shortages or may represent a more general life history adaptation in the great apes. In contrast to orangutans, humans have high energy demands and maintain high activity levels, short interbirth intervals and long lifespans. To investigate energy budgets in great apes, we measured daily energy expenditure in semi-free ranging chimpanzees using the doubly-labeled water method. Energy demands vary depending on life history stage and sex, therefore total energy expenditure, TEE (kCal/day), was assessed in 8 juvenile and 9 adult chimpanzees at the Tchimpounga Chimpanzee Rehabilitation Center in Republic of Congo.

Chimpanzees used considerably less energy than similarly sized humans, and used only 31 – 35% the calories expected for a eutherian mammal of equal body mass. After controlling for body mass, male and female chimpanzees have similar TEE. Though human children devote more energy to growth in their first 24 months and have increased energy needs through the juvenile period, we found no difference in TEE between juvenile and adult chimpanzees in our sample. Chimpanzees and orangutans both show low TEE, suggesting that apes may share an ecologically conservative strategy while humans have evolved a higher TEE that allows for the maintenance of large brains, long juvenile periods and short interbirth intervals.

Mandibular premolar morphology is correlated with dietary toughness in sympatric callitrichids.

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It has been suggested that mandibular premolar molarization in fossil hominins is an adaptation for the consumption of mechanically challenging food items. This study used an extant primate model to test the hypothesis that premolar molarization correlates with dietary toughness. The callitrichids *Callimico goeldii*, *Saguinus fuscicollis*, and *Saguinus labiatus* are closely related and live sympatrically in the Amazon. Although there is significant overlap in the dietary items they consume, their mandibular postcanine morphology differs. Standard metric and 2D geometric morphometric analyses conducted on the mandibular postcanines of these taxa in the collection of the NMNH demonstrate that, even when the effects of differences in body size are taken into account, *Callimico goeldii* and *S. labiatus* have molarized P₄s when compared to *S. fuscicollis*. Food items from the diets of these taxa were collected over a six-week period during the months of June and July 2011 at Camp Callimico, Bolivia and toughness properties were tested using a Lucas field mechanical tester. Among four major food categories (arthropods, exudates, fruits, fungus) masticated by the callitrichid taxa, fungus was found to be significantly tougher than other food items. Fungus accounts for almost one-third the diet of *Callimico goeldii*, and *S. labiatus* is known to consume fungus more often than *S. fuscicollis*, although it does not form a significant part of its diet. In callitrichids, molarized P₄s may be an adaptation that allows taxa to shift to a diet with a higher percentage of tough food items.

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Sex-based differences in the positional behavior of Lowe's guenons and ursine colobus in Boabeng Fiema Monkey Sanctuary, Ghana.

ROBERT L. SCHUBERT. Anthropology, Clark College.

Despite differences in body size and social behavior between males and females of many dimorphic primate species, field observations have identified only very subtle intraspecific sex-based differences in primate positional behavior. In this study, I compare positional behavior profiles for male and female Lowe's guenon (*Cercopithecus campbelli lowei*) and ursine colobus (*Colobus vellerosus*) in Ghana's Boabeng Fiema Monkey Sanctuary (BFMS). Using a 3-minute instantaneous technique, I sampled the behavior of adult individuals of both sexes from guenon and colobus groups at BFMS. I used a G-test ($\alpha=0.05$) to identify significant associations between sex and defined postural and/or locomotor categories within frequency tables generated for each species. For both species, sex and posture (guenon: $p<0.000$; colobus: $p=0.003$) as well as sex and locomotion (guenon: $p=0.011$; colobus: $p=0.034$) were significantly associated variables. Using concurrently collected habitat usage data (the location, size and orientation of supports utilized by a focal animal), I argue that male vigilance behaviors, constraints imposed by larger male body size and dietary differences between males and females drive these subtle postural and locomotor

differences. However, the overall similarity between sexes in preferred postures or locomotor behaviors suggests that evolutionary history exerts a greater constraint on positional behavior than sex. These subtle intraspecific differences reinforce the finding of other field studies that positional behavior is largely conservative within primate clades.

Enough time to become smart: skill learning in immature orangutans.

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Sumatran orangutans (*Pongo abelii*) show the latest age of first reproduction and longest nutritional dependence of any nonhuman primate. Sumatran orangutans live in a highly skill intense foraging niche including extractive foraging and tool use. In this study on wild Sumatran orangutans at Suaq Balimbing Indonesia, we could show that immatures reach competence in foraging skills well before age of first reproduction: soon after weaning they have reached diet compositions, food processing rates and competence in finding food equal to those of their mothers. Consequently, the late age of first reproduction in Sumatran orangutans cannot be determined by the time to acquire foraging skills but rather by the energetic constraints of reaching adult body size. However, we also found that the slow somatic development provides immatures with a surfeit of time for skill learning: by vertical transmission (expressed in selective peering to, and food sharing with, the mother), by high rates of independent exploration during infancy, and by post-weaning associations with conspecifics. In the latter context, they pay close attention towards close by feeding party members, expressed by high peering rates, consistent with the presence of horizontal transmission of feeding innovations. We compare this pattern of energy limiting the age at first reproduction in orangutans with that seen in human foragers, where adult skill levels are reached well after the onset of reproduction, and propose that provisioning during the learning period allowed our ancestors to evolve an even more skill-intensive foraging niche.

The timing and process of the colonization of South America: a North American perspective.

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Today, as in the era of Hrdlička, the key issues for understanding the prehistory of the Americas are the number of migrations that contributed to the diversity of Native American populations and the time at which the ancestral population(s) initially entered the New World. Recent studies of mtDNA and nuclear DNA variation in the Americas support the Beringian Incubation Model, in which the ancestral

population entered the New World some 20,000-15,000 YBP after having genetically diverged from sister populations in Asia. However, other genetic and osteology studies suggest that two major population expansions gave rise to the biological diversity observed in the Americas. We have re-examined these key questions through high-resolution analysis of mtDNAs and Y-chromosomes from Siberia and North America. Phylogeographic analysis of whole mtDNA genome sequences from haplogroups A2, B4, C1, D1 and X2, and a similar analysis of Y-chromosome haplogroups Q1a3a* (M346), Q1a3a (M3) and C3 (M217), reveal distinct sets of maternal and paternal lineages in both Amerindian and circumarctic populations, with the latter reflecting population expansions occurring over the past 5,000-10,000 years. In addition, our analysis of Q1a3a* in Siberia and the Americas has allowed us to reshape the phylogeny of this branch, clarify genetic connections between populations from these two regions, and generate new coalescence estimates for derived branches in the Americas. These data have important implications for the timing and process of the colonization of South America, and, in particular, the type and number of founding haplogroups which first reached this region.

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The interrelationship of diet and status in early medieval Alamannic societies.

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Humans use dietary behaviour as an expression of biocultural identity and display, a feature linked with social inequality and socio-political circumstances that define prevailing subsistence strategies. Despite these known connections, the extent to which dietary choice develops with social differentiation in past populations is not well understood. Early medieval societies (5th-8th century AD) provide ideal cases to test whether, why and how dietary choice and status begin and continue to co-vary. Characterised as open rank societies they are defined by acquired status and privileges that result in obligations to a ruler. This translates into wealth disparity and varying status. In death, grave inclusions and burial effort reflect and display rank attained during life.

Carbon and nitrogen isotope ratios of human bone collagen and associated faunal samples (total N=116) of two populations reveal different, time-related principles, in which status manifests itself in dietary options. At Pleidelsheim, an earlier formative site, there is a moderate association between dietary quality and number of grave goods and artefact types, while burial type is a very good predictor of protein consumption across the entire sample. At the later site of Kirchheim, nitrogen values suggest that only individuals associated with horse

burials in a nobles' burial site had regular access to higher levels of animal protein compared with the rest of the population, reflecting more firmly established social structures under Frankish rule. The findings demonstrate the possibility to detect how even subtle dietary differences reflect strategies to display social variation.

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Will it be a boom or a bust: the last fifty years of juvenile research in physical anthropology and implications for future research.

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Research on human juvenile remains and ontogenetic data has long been important in understanding human variation and adaptation. These studies have been used to explore differences among hominin species, patterns of health among groups practicing different subsistence economies, and the development of adult morphologies. Papers and meetings presentations from the last two decades have especially highlighted the utility and many applications of juvenile research. However, trends in the quantity and types of studies on juveniles have not been examined.

This study investigates patterns in the frequency of juvenile studies through a survey of meeting abstracts and articles published in the American Journal of Physical Anthropology from 1950 to 2011. Only publications in which human subadults are used as the primary or a comparative sample are considered. Results reveal that very few papers incorporated juvenile remains prior to 1990. A significant increase in publications occurs after 1990. Since 1995, anthropological studies of juveniles have remained fairly constant; the proportion of American Journal of Physical Anthropology articles focusing on juveniles has only risen slightly between 1995 and 2011. A small increase in cultural and biomedical studies on modern living children, not skeletal populations, has driven this increase.

This survey of the literature highlights an increased focus on understanding juvenile human biology and morphology in the last two decades. Moreover, the breadth of study topics has grown, reflecting greater research focus, increased availability of data, and more sophisticated analytical methods.

Coins, kids, and culture: an examination of grave goods and health at the Drawsko 1 cemetery site (17th – 18th centuries).

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Coins have been used for centuries as the mainstay of commerce; they have also played an important symbolic role in mortuary contexts. Coins accompanying burials is perhaps most notably described in Greek history, but was also

present in post-medieval Poland. The Drawsko 1 site is unique in that it has evidence of deviant burials correlated to Slavic folklore and vampires. Historical records from this period regarding such burials suggest that the inclusion of coins may have provided protection to the soul after death. At Drawsko, 73 subadults have been recovered and 26 of these individuals were buried with coins (36%). The argument is made that subadults were more vulnerable to vampirism and, therefore, were more consistently buried with coins for protection. However, not all subadults were buried with coins, suggesting that some individuals were perhaps more vulnerable than others. We hypothesize that this vulnerability is correlated with biological health. Subadults were examined for evidence of stress, dietary deficiencies, infection, and trauma. However, results indicate that rates of pathological conditions did not differ significantly between subadults interred with coins and those not buried with coins (chi-square, $p < 0.05$). These unexpected results suggest that some factor other than health was used to determine whether a child should receive special protection in their interment. We conclude that social factors played a more significant role in mortuary patterning than biology.

Does this face make my teeth look big? Molar size, size-adjustment, and dietary adaptation in strepsirrhine primates.

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Among the Strepsirrhini, relative molar size does not exhibit a dietary signal when body mass is used to scale molar dimensions. This observation is also true for anthropoid primates, but when the size of the facial skeleton is used to scale postcanine dimensions in this clade, folivores tend to have relatively larger postcanine teeth than frugivores. Notably, facial size appears to have a stronger influence than body mass on postcanine size in anthropoids, suggesting that facial size is the more appropriate variable for size-adjusting the postcanine dentition. The goal of this study was to determine whether this pattern of relationships also characterizes strepsirrhines. Data on molar area, skull size (a geometric mean composed primarily of measurements of the facial skeleton or the facial skeleton's interface with the neurocranium), and body mass for thirty-seven extant strepsirrhine species were taken from the literature and analyzed using phylogenetic comparative methods. Results indicate that strepsirrhines are similar to anthropoids: when skull size is used to size-adjust molar area, folivores tend to have relatively larger molars than frugivores and insectivores. Moreover, the partial correlation between molar area and skull size holding body mass constant is strong and highly significant, whereas the partial correlation between molar area and body mass holding skull size constant is weak and nonsignificant. These results confirm the generality of the anthropoid pattern and support the idea that elements of the masticatory system should, in some contexts, be considered relative to their functional and developmental environments in studies of dietary adaptation.

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Dental microwear texture analysis of fossil bovids from Hadar, Ethiopia: implications for the paleoenvironment of *Australopithecus afarensis*.

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Considerable paleoecological research has focused on the Pliocene locality of Hadar in Ethiopia, due to the long occupation by *Australopithecus afarensis*. In order to better understand the adaptations of these early hominins, it is necessary that reconstructions of the paleoenvironment are as accurate as possible. This study employs dental microwear texture analysis to reconstruct the diets of the local bovid fauna, frequently used as indicator taxa for habitat. To interpret the microwear signatures, the Hadar taxa are compared to a database including 25 extant bovid species with well understood diet and habitat preferences. This paper also addresses the paleoenvironments of the Sidi Hakoma, Denen Dora and Kada Hadar Members, as inferred from the dietary data. Clear differences in microwear textures were present among the members. The Sidi Hakoma bovids are reconstructed as browsers or browser-grazer intermediates, suggesting closed habitats and the presence of woodland resources. The Denen Dora bovids evince microwear textures ranging from obligate grazers to browser-grazer intermediates, indicating a mosaic habitat with access to both browse and graze. The Kada Hadar bovids primarily have variable or obligate grazing signatures, although a few browsing taxa are present. This suggests open habitats for grazing, although the presence of browsing taxa supports a mosaic reconstruction for this member. The results presented here are consistent with a gradual aridification trend at Hadar. The microwear signatures of the fossil bovids indicate a transition from closed habitats comprising the Sidi Hakoma Member to a more open environment by the time of Kada Hadar deposition.

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Variation in Australian Aboriginal diets: contrasting dental patterns from South Australia.

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Studies of Australian Aboriginal teeth have often concentrated upon the extent and patterning of dental wear emphasizing the abrasive nature of hunter-gatherer diets or the use of teeth as tools but have rarely undergone more complete analyses of dental pathology or examined variation between individuals or groups. In this study, we analyse dental remains from two coastal areas of Southern Australia examining dental microwear and dental

pathology in order to evaluate the level of variability across space.

The two samples, from Gilman mound and Yorke Peninsula, are held at the South Australian Museum and were recorded as part of an ongoing collaborative project with Aboriginal communities. The Gilman remains (n=17 individuals) come from one mound with burials dated between 1000 - 500 years BP. In contrast, the Yorke Peninsula remains (n=24) come from a range of undated locations. Some of these remains are postcontact as indicated through pipe facets or burial inclusions associated with the skeletons. The dental conditions recorded include macrowear, caries, calculus, AMTL, abscessing, and periodontal disease. Dental microwear was assessed by quantifying the microwear features of pits and scratches from images taken using a scanning electron microscope.

Based on previous evidence, both sets of remains could be expected to be exploiting similar resources (with the exception of postcontact remains). While the pattern of dental pathology is dominated by severe dental wear, there are, however, striking differences in the pattern of wear and the accumulation of dental calculus, which may be due to differential exploitation of food resources.

Dental calculus: a new proxy for estimating stable carbon and nitrogen isotope compositions.

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Dental calculus from 58 medieval and post-medieval skeletons from Vitoria, Spain and a single Alaskan Inuit skeleton were tested for stable carbon and nitrogen isotopes. There are several sources of carbon and nitrogen in calculus, including oral mucosa, saliva, food particles, and oral bacteria. There was sufficient carbon and nitrogen to obtain consistent $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values. Results were replicable and comparable to European values based on bone collagen, with means of -21.2 for $\delta^{13}\text{C}$ and +11.8 for $\delta^{15}\text{N}$. The single Alaskan Inuit yielded a $\delta^{15}\text{N}$ value of +17.5‰, consistent with data on modern Greenlandic Inuit consuming a diet rich in marine food. Calculus is a secondary biomaterial that is not an integral part of the dental or skeletal system. As such, dental calculus may provide a new avenue for paleodietary research where the use of primary biomaterials is precluded.

Ecomorphology and phylogeny among the Bovidae: implications for habitat reconstruction.

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Reconstructions of paleohabitats provide critical contextual information for understanding hominin evolution. The morphology of species from relevant sites understood in terms of functional relationships to habitat (termed ecomorphology) offers a direct link to habitat. Ecomorphology has been preferred as a "taxon-free" approach.

Bovids are common in ecomorphological analyses, but bovid phylogeny and habitat are not uncorrelated raising the possibility (as argued by Klein and colleagues) that analyses are anything but "taxon free." We analyze two relative dimensions of the bovid metatarsal previously found to have strong associations with habitat (relative midshaft width and relative metatarsal length) using PGLS to estimate potential phylogenetic effects.

Eleven measurements were taken on 361 bovid and 11 antilocaprid metatarsals from 74 extant bovids and one extant antilocaprid. Ratios of length and midshaft width versus a geometric mean size proxy were fit to PGLS models using the phylogeny of Hernández Fernández and Vrba. A first set of models including the ratios and size proxy showed the expected strong phylogenetic signal with lambda of 0.94 for relative length and 0.74 for relative midshaft width. Models including habitat resulted in a lambda of 0.88 for relative length and lambda bounded at zero for relative midshaft width and yielded significant habitat effects.

Clearly, phylogeny, morphology, and habitat all march together. Notably, bovid metatarsal midshaft width appears less likely to be confounded by phylogeny. We suggest that the way forward for ecomorphology is grounded in functionally relevant observations and careful consideration of phylogeny designed to bracket probable habitat preferences appropriately.

Y-Genotyping of the J haplogroup in Yemeni samples.

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Yemen, with its key location in the Arabian Peninsula along a southern migration route out of Africa, represents a significant area of interest with respect to human migration. The prevalence of J haplogroups in the Arabian Peninsula and high frequency in European populations, suggests this group is ideal for understanding the European contribution and diffusion into the Arabian Peninsula and Africa. To facilitate the examination of genetic patterns in southern Arabia, Y-genotyping was employed to analyze 265 male samples, collected throughout Yemen. Specifically, 35% of samples were found to carry the J-12f2a-defining single nucleotide polymorphism, while 15% pertained to the DE-YAP-defined group, with the remaining 45% belonging to the F-M89 group. These J haplogroup samples were further genotyped to classify them into specific J haplotypes. After observing the resultant categories, the relative frequencies of each were compared with those of surrounding regions. Our results help illustrate the phylogeographic

processes that shaped current genetic variation in Yemen with implications for a better understanding of the evolutionary history of the Arabian Peninsula.

Testing evolutionary mechanisms for patterns of craniofacial morphology: distinguishing between neutral forces and selective forces of evolution.

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Recent studies have investigated the degree to which cranial morphology reflects population history under control of stochastic microevolutionary processes or conversely, is related to adaptive changes reflected in diverse environmental conditions. Most studies suggest that changes in cranial morphology preserve a strong population history signal and a weaker adaptive or dietary signal. In contrast, some studies have indicated that size-related craniometrics such as cranial form or nasal aperture shape are influenced by selective forces, primarily climatic in nature. Therefore there is still some debate about the use of craniofacial morphology as a legitimate tool to recover recent human evolutionary and population history.

Here, we aim to provide a framework for distinguishing between neutral forces and selective forces of evolution as a guide to improve our use of craniofacial traits for reconstructing population history. Twenty-four craniofacial measurements and 15 craniofacial indices from Africa and Europe were used to test whether the observed morphological patterns are due to natural selection and shaped by differences in climate, or to neutral processes and/or gene flow. Data were subjected to non-parametric correlation tests, the Relethford-Blangero method, and spatial analysis, including a test of the 'isolation-by-distance' model using Mantel matrix correlation.

Our results indicate the configuration of face and skull modules appears to be neutral. However, weak correlations exist between morphology and climatic variables, specifically nasal and facial height. These correlations indicate some adaptive value to climate, whether from diversifying selection or cultural buffering. These facial dimensions may be useful for investigating various selective pressures.

New material of *Biretia*, the oldest undoubted anthropoid from Afro-Arabia.

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Recent work at Birket Qarun Locality 2 (BQ-2), an earliest late Eocene (~37 Ma) locality in the Fayum Depression of northern Egypt, led to the recovery of abundant remains of primates and other mammals, including new specimens attributable to *Biretia*, the oldest undoubted anthropoid from Afro-Arabia. Among the new *Biretia* specimens are more complete

mandibular remains, a partial maxilla, a number of isolated teeth, and a partial calcaneus. The maxilla of *Biretia megalopsis* preserves a vertically oriented nasolacrimal duct, a small part of the orbital rim, alveoli for the upper canine and P²⁻³, and the crowns of P⁴-M¹. The fragment of the orbital rim is small (~3.5 mm), but based on the preserved morphology, the predicted orbital diameter of the specimen (plotted against M¹ area) suggests that *Biretia* was a diurnal primate. If this inference is correct, the orbitopalatal fusion of *Biretia*, previously interpreted as a possible indication of orbital hypertrophy and nocturnality, would require an alternative functional explanation. The mandibular symphysis is unfused, providing new support for the hypothesis that symphyseal fusion evolved independently in parithecids. The P² is one-rooted, suggesting that the isolated three-rooted tooth previously interpreted as a P² of *Biretia fayumensis* might be a very small P³. The calcaneus has a short and tightly curved ectal facet. Phylogenetic analysis incorporating this new evidence continues to place *Biretia* as a basal parithecoid, and inclusion of recently described specimens of the older African primates *Azibius* and *Algeripithecus* confirms that these genera are not anthropoids but stem strepsirrhines.

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The effect of female preference on male integration in a captive rhesus macaque social group (*Macaca mulatta*).

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Among rhesus macaques, male immigration into new social groups is facilitated by affiliation and sexual relationships with females and hindered by competition with resident males. Because resident males interfere with females' attempts to affiliate with novel males, it can be difficult to assess the degree to which female preference facilitates novel male integration. Here, we evaluate the role of grooming in facilitating male integration by assessing the changes in female grooming behavior associated with replacement of resident natal males with novel males in a captive social group at the California National Primate Research Center (CNPRC). The results show that females directed a greater proportion of total grooming bouts towards novel (x=.50) versus natal (x=.25) males (LR X²=20.69; df=1; p<0.0001). Among novel males, sexually mature (>5 years of age) males received a higher number of grooming bouts (x=12 bouts versus x=2 bouts) than sub-adult (4-5 years of age) males (LR X²=16.66; df=1; p<0.0001). Additionally, amount of female grooming received was negatively correlated with trauma rates among males and positively correlated with

male survivorship in the group. Our data supports female preference of sexually mature, novel males, and grooming as a mechanism of successful integration. These results in combination with data presented by Hannibal et al. (these proceedings) suggest that novel male relationships with resident females are more important than male competition in determining male integration into rhesus macaque social groups.

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Bony responses associated with a malaria infection.

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Malaria is a disease that affects over 250 million people per year in 106 malaria-endemic countries (World Health Organization 2010). Although malaria has a large effect upon humanity, this disease has received relatively little attention from a paleopathological perspective. Most of the research concerning this pathogen has been conducted from a biomedical paradigm, which is marginally useful when examining skeletal remains from archaeological contexts. While some anthropologist have employed molecular genetics to diagnose malaria in human remains, only a few researchers, such as Angel (1966), Stuart-Macadam (1992), and Walker et al. (2009), have specifically considered the role of malaria in the formation of bony responses including porotic hyperostosis and cribra orbitalia. However, in order to formulate the *a priori* assumptions necessary to make a differential diagnosis of a disease, one must first observe and record the pathologies of individuals who were afflicted with the condition (Buikstra 1976:324).

This study represents a documentation of the bony responses observed in a person who was infected with malaria at the time of his death. For this study, an individual from the Hamann-Todd collection at the Cleveland Museum of Natural History was examined. Examples of bony responses observed included porotic hyperostosis and discoloration of the articular surfaces of shoulder, hip, and iliosacral joints. The interpretations of these observations and the limitations and implications of these findings are discussed, as well as directions for future research relating to malaria and skeletal remains.

Modern human fossils from Tam Pa Ling, Laos.

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Uncertainties surround the timing of modern human emergence and occupation in East and Southeast Asia. Following a gap in the East Asian hominin fossil record from 100-40 ka, the earliest paleoanthropological evidence of definitively modern human occupation is at Tianyuan Cave, China (ca. 40 ka). Genetic data, however, indicate that humans migrated out of Africa using a southern route into Southeast Asia by at least 60 ka before continuing northward into East Asia. Patterns of genetic variation in recent human populations as well as results from recent studies of ancient DNA point to Southeast Asia as an important source for the peopling of East Asia. Here we introduce newly discovered modern human fossils from Tam Pa Ling, a cave site in Hua Pan Province, Laos, dated to ca. 50 ka. These remains establish the earliest presence of humans in mainland Southeast Asia and bridge the temporal discrepancy that has previously existed between paleoanthropological and genetic evidence for modern human occupation in the region. Additionally, they provide evidence of alternative routes of migration for modern human populations in eastern Asia during the Late Pleistocene. We report on the paleoanthropological and geological record of Tam Pa Ling, including geochronology and biostratigraphy of the site. Additionally, morphological analyses of these fossils are performed relative to available Late Pleistocene and Holocene East and Southeast Asian fossils to assess the morphological affinities of Tam Pa Ling and make inferences regarding Pleistocene migrations in East Asia.

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GIS analysis of the ranging behavior, group cohesiveness, and patch use of bearded sakis (*Chiropotes sagulatus*) in the Upper Essequibo Conservation Concession, Guyana.

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Northern bearded sakis (*Chiropotes sagulatus*) have among the largest home and day ranges of any neotropical primate. Yet the specific reasons for such large ranges and the relationship between ranging, group cohesiveness, and food patch size and quality are not well known. In one of the few studies conducted in continuous forest, I found that bearded sakis in Guyana had a home range of over 800 ha and an average day range of 4 km. The sakis used a core area of 250 ha and large

daily path lengths (sometimes exceeding 6 km) allowed them to cover much of their home range over the course of a few days. Home range use varied seasonally, as different areas of the range became more productive, although daily path lengths showed little seasonal variation.

I used GIS to quantitatively define bearded saki food patches and correlate saki group spread with food patch size and quality. Patches were defined on three spatial scales using several variables, including number of feeding trees, dbh, crown area, and phenology. Sakis were more cohesive when exploiting large, high quality patches. When feeding on lower quality resources, saki group spread increased, and feeding parties of 3-6 individuals fed from many trees simultaneously. Daily path length was correlated with overall patch quality.

This research has implications for how researchers define food patches, a notoriously difficult task for primatologists, and introduces GIS as a powerful tool for analyzing primate patch use and how it relates to ranging patterns.

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Play behavior in captive black crested mangabeys (*Lophocebus aterrimus*).

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The study of animal play provides valuable information about behavioral and cognitive development, and informs the full behavioral repertoire of a species at all stages of its life-history. We conducted a study of play in black crested mangabeys (*Lophocebus aterrimus*) at the San Antonio Zoo and Aquarium. Currently, little is known about play in this species. We observed two socially-housed groups of seven individuals in total. We recorded various play categories: solitary locomotor-rotational play, object play, and social play. Additionally, we recorded rates of social play between individuals, and analyzed overall play frequency according to age-sex categories.

Overall, play accounted for 15.4% of observed behavior. Consistent with previous studies, juveniles played more frequently than did adults. However, preliminary analyses show that adults played more frequently than predicted by the literature (24.3% of total play observed). Adult-juvenile play dyads accounted for most (89.5%) of play in adults. Compared with the adult females, the adult male of the group spent significantly more time engaged in social play with his juvenile offspring. Adult females on average engaged in 5.37% fewer instances of social play with juveniles compared with the adult male regardless of sex, or relatedness to the juvenile play partner. This is surprising since adult-juvenile social play interactions in other primates reportedly occur most frequently between mothers and their offspring. These findings may be explained by group composition and age- and sex-preferences in play partners.

To investigate differences in social play between individuals, signals and directionality of initiation gestures are also discussed.

Determining sources of dental microwear texture variation in anthropoids.

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Hominin species have very different amounts of variation in dental microwear textures (DMT), but it is unclear how much of this variation is due to differences in diet and how much to other causes of microwear variation such as habitat, e.g., living in a dry dusty environment, or sampling from across time for a single species. Determining the sources of variation in microwear is important for understanding the dietary niche breadth of a species.

To understand the amount of variation within and among closely related fossil species, an analysis of DMT from modern taxa must be conducted to consider site, seasonal and time variation within individual species. I compared variation of four DMT variables in a sample of anthropoid primates using Levene's test. Overall, most species did not differ significantly in DMT variation, although complexity (*Asfc*) in *Cebus apella* was significantly greater than other species in the sample. *Cebus apella* may have greater variation because of a more varied diet, but individuals from different sites, seasons, and years may also have increased the variation in this sample. In contrast, the species with the most homogeneous collection background had the lowest variation in two of four variables considered; this low variation may arise from the homogeneous sample or from low variation in diet. These results indicate the need for examination of more species obtained as homogeneous specimens in order to assess the contribution of diet breadth versus habitat, season, and temporal variation to overall species DMT variation.

Phylogenetic and locomotor signals in the primate bony pelvis: a multivariate approach.

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The primate bony pelvis has been an important target for comparative anatomists over the past century, particularly in the investigation of locomotion. In spite of this fact, few studies approach bony pelvic anatomy from the perspective of multivariate analysis. Here a multivariate approach examines pelvic variation across both suborders of Primates, encompassing the full range of extant locomotor regimes. The aim of this work was to examine the relationship between anatomical variation, locomotor mode, and phylogeny. Measurements of 15 pelvic variables were collected on 258 specimens, representing 43 primate species. Principal component analysis resulted in 80% of the variation within the pelvis being accounted for by the first three principal components (PC). PC 1 loaded positively with iliac breadth and ischial tuberosity measurements, and negatively with iliac height. PC 2 loaded positively with iliac breadth and negatively with ischial tuberosity measurements and pubic symphysis length. PC 3 loaded positively with lower iliac breadth,

breadth of the iliac tuberosity, and pubic symphysis length, and negatively with superior iliac breadth and ischial tuberosity measurements. These results suggest that PC 1 and 2 account more for the effects of phylogeny, rather than functional adaptation to locomotor regime, while PC 3 seems to be more indicative of pelvic locomotor adaptation. PC 3 groups the great apes and lorises, suggesting an adaptation to the flexibility necessary for climbing. The results of this analysis have interesting applications to studies of fossil primates, suggesting that a knowledge of phylogeny is necessary for interpreting locomotor anatomy.

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The origin and evolution of primate quadrupedalism: insights from marsupials.

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Reconstructing primate locomotor evolution relies on fossils in conjunction with extant analogs. For example, the marsupial *Caluromys* has been used to model an ancestral condition characterized by terminal branch feeding, elongated digits and powerful grasping. Even with elongated digits, the ability to effectively grasp or stabilize the body on arboreal substrates is simultaneously dependent on substrate size, body size and hand/foot proportions. We compare the effects of relative body and hand size on quadrupedal kinematics in two small-bodied marsupials, *Petaurus breviceps* (arboreal) and *Monodelphis domestica* (terrestrial). Longitudinal data were collected from 4 juvenile *Petaurus* (33-75g) and 2 juvenile *Monodelphis* (26-65 g), walking across poles of diameter 2.5, 1.0, and 0.5 cm.

Hands were relatively longer in *Petaurus*, and on the smallest pole, reached 121% of pole circumference vs. 89% in *Monodelphis*. *Monodelphis* enhanced stability with higher duty factors and more limb support compared to *Petaurus*, but within-species patterns differed. As substrate size decreased relative to body or hand size, *Petaurus* increased duty factors and limb support, and these features were more pronounced at younger ages, whereas *Monodelphis* showed less kinematic flexibility. Results confirm that *Monodelphis* is at a mechanical disadvantage even when its hands encompass > 50% of substrate circumference. Moreover, *Petaurus*' responses to decreases in substrate size suggest that hands encompassing most or all of substrate circumference do not necessarily offset challenges to stability incurred by relative body size. Therefore, "grasping" ability in early primates or their ancestors should be considered together with substrate diameter and body size.

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The effect of microclimate characteristics on time to skeletonization in clothed and nude *Sus scrofa domestica* subjects in an arid SW US environment.

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This project explores forensic taphonomy focusing on the decomposition process for clothed and unclothed subjects as well as understanding the Cadaver Decomposition Island (CDI) where nutrients and bacteria are released from the remains. The decomposition aspect involves the time to produce a skeleton in three microclimates in an arid Southwestern United States environment on clothed and unclothed domestic pig (*Sus scrofa domestica*) subjects. Six subjects were placed in pairs of one clothed and one unclothed pig in wire enclosures in three outdoor microclimates: full shade, partial sun, and full sun. Observations of the subjects' environment and decomposition progress were made regularly for forty days, at which point changes ceased to occur hourly. Subjects were then observed every third day for fourteen days, and then once a week for twenty eight days. Prior to placing the subjects on-site (June 5, 2011) and after skeletonization occurred (August 28, 2009 and January 5, 2010), soil samples were taken from the study locations directly beneath the subjects as well as control samples from outside the experimental locations. The pH, electroconductivity, and nitrates were tested in the soil samples to understand the chemical characteristics. Subjects in shade and partial shade locations reached the skeletal stage prior to the subjects located in the sun, with the clothed subject located in full shade reaching skeletonization first. Soil samples showed a general increase in acidity and salt content.

The unique bilateral strength asymmetry and cross-sectional shape of Neandertal humeri may reflect adaptation to scraping tasks, but not spear thrusting.

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Aspects of Neandertal skeletal anatomy that fall outside the range of modern human morphological variation may reflect osseous adaptation to specific activities. Indirect experimental evidence has supported the hypothesis that spear thrusting plausibly explains two of these skeletal attributes: a) pronounced (right-side dominant) humeral bilateral strength (J) asymmetry and, b) anteroposteriorly reinforced mid-diaphyseal cross-sectional shape (Ix/Iy) in both the right and left arm. However, alternative habitual tasks have not been evaluated. To extend this line of inquiry, muscle activity was measured using surface electromyography at the right and left *pectoralis major* (PM) as well as the *anterior* (AD) and *posterior* (PD) *deltoid* during the performance of various 'spear thrusting' and 'hide scraping'

tasks. Contrary to published predictions of greater dominant limb (right-side) muscle activity during spear thrusting, bilateral comparisons measured during three separate spearing activities reveal significantly greater non-dominant (left-side) innervation of the shoulder (AD, PD) and chest (PM) musculature. Similar bilateral comparisons performed during single-handed, 'pushing', 'pulling' and 'hacking' scraping tasks reveal significantly greater dominant-limb muscle activity at these same muscles (AD and PM). In contrast, the performance of a two-handed 'vertical pull-down' scraping technique caused significantly greater non-dominant-limb muscle activity. These measures of *in vivo* muscle activity do not support previous attempts to link unique skeletal attributes of the Neandertal and Palaeolithic *Homo sapiens* humeri to bimanual spearing tasks. The question remains whether a more repetitive, yet still physically demanding, task might better explain these unique humeral adaptations.

Fossil macaque from Middle Pleistocene of Gajtan Cave, Albania, aligns with *Macaca sylvanus* via geometric morphometric analysis.

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Macaca is the extant sister-taxon to all other papionin cercopithecines, corresponding to its geographical distribution in North Africa and Eurasia, versus the essentially sub-Saharan distribution of other extant papionins. Within *Macaca*, molecular studies place North African *M. sylvanus* as the sister to the Asian subclades. Fossil macaques from Asia are represented by partial crania, but their phylogenetic position is not well-known. European Plio-Pleistocene macaques include the distinct *M. majori* and gnathic fragments assigned to *M. sylvanus* (mainly because of geographic and size similarity). Until now, no *M. cf. sylvanus* fossil has been complete enough to compare with extant taxa cranially, but a maxillofacial fragment recovered by Anton Fistani at Gajtan Cave (in a mammalian assemblage indicating a later Middle Pleistocene age) preserves sufficient morphology to permit comparison with 14 macaque crania representing about a dozen extant species (whose taxonomy is still in flux), with crania of two *Papio hamadryas* subspecies and *Cercocebus torquatus* as outgroups. This sample was subjected to 3D geometric morphometric analysis in which surface scans were tagged with 22 landmarks (Types I and II), 6 curves (3 points evenly interspersed with 10 semilandmark points), and 1 surface semilandmark patch (9x9) in Landmark Editor and then subjected to GPA and PCA in *morphologika*. The results of the geometric morphometric analyses corroborate molecular evidence that *Macaca sylvanus* is the sister to all extant Asian macaques and align the fossil closely with *Macaca sylvanus*, the first positive

support for this referral (and potentially that of other European fossils).

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Costly signaling in young male chimpanzees and humans: implications for early Hominin behavior.

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Costly signals are public signals that incur actual or potential costs to senders, and provide information about their phenotypic quality to potential mates, allies or competitors. Costly signaling has been observed in multiple human communities, particularly among young males, and costly signaling theory (CST) has been used to explain risky behaviors among those males. Previous research has suggested that chimpanzees engage in costly signaling, especially during risky behaviors such as boundary patrols and hunting, but no studies have explicitly applied CST to data on young (juvenile, adolescent and young adult) male chimpanzee behavior. I present comparative data on the behaviors of young male chimpanzees and humans during risky behaviors that address this gap, and provide information relevant to behavioral reconstructions of early Hominins. I collected data on young male chimpanzee participation in and behavior during boundary patrols and hunting during a 16-month study at Ngogo Kibale National Park, Uganda. I used published and unpublished data on young male human participation in risky behaviors. Young male chimpanzees and humans engage in costly signaling, and their willingness to take risks increases with age. Further, their participation in risky behaviors impacts their ability to attract social partners and potential allies. These results indicate that costly signals are important social tools used by male chimpanzees and humans during social development to communicate quality as a social partner, and to assess potential allies. When combined the two sets of results indicate that costly signaling was likely an important tool for our earliest Hominin ancestors.

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Documented secular change in epiphyseal union timing and dimensions of the clavicle.

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This presentation synthesizes data on secular change in clavicle fusion and dimensions in the American population from 1840-1980 birth cohorts to provide a comprehensive assessment of developmental and morphological change in the clavicle. Langley-Shirley and Jantz (2010) documented secular changes in fusion

timing of the medial clavicular epiphysis in Americans during the past century. They found that fusion commenced four years earlier in mid to late 20th century birth cohorts (1955-1985) compared to late 19th and early 20th century cohorts (1880-1935). Shirley and Cridlin (2011) noted an increase in clavicle length in birth cohorts from 1850-1920 and a decrease from 1920-1970.

The combined sample for this analysis consists of the Forensic Data Bank (n=1239), a modern autopsy sample from East Tennessee (McCormick Clavicle Collection, n=1137), McKern and Stewart Korean War males (n=341), and 354 individuals from the Hamann-Todd Collection. The total sample size is 3071 (2277 males, 794 females). LOESS regression was used to examine overall trends in clavicle length, and piecewise regression was applied to determine breakpoints in the data. Piecewise regressive models indicate a breakpoint around 1910-1920 in both sexes. Fluctuations in clavicle length are in general agreement with fluctuations in cranial and facial breadth. This is not unexpected, as certain genetic disorders (cranioleido-dysostosis) indicate a likely developmental link between the clavicle and cranium.

This preliminary analysis suggests that (1) earlier fusion timing and decreased clavicle length are not linked or (2) further refinement of the sample groups will elucidate the relationship between maturation timing and adult morphology.

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Morphometric variation in human crania from prehistoric California.

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California has played an influential role in the American tradition of physical anthropology, providing an extraordinary record of human settlement and adaptation in the New World. Many early anthropometric studies documented physical variation in native Californian populations, and much of this work has been continued by subsequent investigations. In the most extensive study of Californian anthropometry to date, E. W. Gifford (1926) distinguished seven cranial types throughout native California, based largely on craniometric indices and anthroposcopic assessment. In the present study, we tested Gifford's typology with geometric morphometrics (GM), using samples of crania from his original study. Three-dimensional coordinates of 30 craniometric landmarks were recorded from laser scanner models and analyzed with MorphoJ software. Following generalized Procrustes analysis (GPA), we generated average landmark configurations for each group that could be directly compared with a consensus configuration for the entire sample. Between-group differences were also quantified with canonical variates analysis (CVA). Our

preliminary GM analyses revealed some patterns similar to those described by Gifford, including a strong morphological resemblance between Great Basin and Santa Catalina cranial types, and overall intermediate morphology in the San Francisco and San Joaquin types. However, other patterns were contrary to Gifford's observations, such as long and narrow nasal morphology in the Santa Catalina group. Although CVA showed statistically significant ($p=0.05$) Mahalanobis distances between all group centroids, only 40% of crania were correctly classified into these groups after leave-one-out cross validation. Ongoing research in this area will further understanding and facilitate interpretations of Californian craniometric variation.

Sugar, health, and slavery: forty years of bioarchaeological research at Newton Plantation, Barbados.

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Newton Plantation (ca. 1660-1820), Barbados has provided insight into the lives of enslaved Africans for 40 years. Excavations by Handler (1971-1973) led to craniodental studies (n=101) by Corruccini and colleagues, supporting extremely poor nutrition [LEH (20%), hypercementosis (89.4%), caries (20%)], congenital syphilis (3%), and disparities between skeletal (29 years) and historical (20 years) life expectancy. High bone lead (117.6+/-94.9 µg/g) suggested epidemic levels of lead poisoning from contaminated rum, but bone lead has since become suspected of diagenesis. Subsequent excavations (n= 49 plus 35-40 commingled) by Shuler and Pasquariello (1997-1998) revealed skeletal life expectancy (19.95 years) closer to historic predictions, similar LEH and caries rates, high periostitis (41%), and low mean stature in males (169 cm) and females (159 cm), but a surprising lack of severe and/or historically-documented diseases (e.g., syphilis, TB, leprosy). Isotope analyses ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{18}\text{O}$ and $^{87/86}\text{Sr}$) on bone and dental material by Schroeder and colleagues provided the first clear evidence of Barbadian (n=18) versus African birth (n=7). Most recently, we have explored the potential for alcohol-related birth defects due to ethanol and lead exposure within this population. High dental lead (0.2 µg/g to 47.3 µg/g) values, equivalent to blood values of 2.0 µg/dl to 473 µg/dl, correlate with early mortality ($p=0.079$) but not with congenital defects (e.g., co-occurring vertebral and mandibular anomalies), which was unanticipated. Here, we synthesize 40 years of geospatial, mortuary, osteological, and biochemical data from Newton to discuss quality of life for these enslaved sugar producers within a larger global and temporal framework.

Opisthocranium migration: female progenesis in the vervet (*Chlorocebus aethiops*) cranium.

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Several investigations into intraspecific differences in patterns of growth and development of the vervet monkey (*Chlorocebus aethiops*) have found progenesis (early growth cessation) in females, but the effect of this developmental difference on the cranium has not been investigated. This study seeks to correct this deficiency by examining skeletons of 36 individuals from a single, wild population from Kibwezi, Kenya. The sample is comprised of both males (n=17) and females (n=19) that range in age from infant to adult. The specimens were placed into discrete age classes using previously established dental eruption patterns. These classes were then plotted against the distance from opisthocranium to lambda suture.

The distance from opisthocranium to lambda suture was found to shrink throughout ontogeny in both sexes, but remains relatively large in adult females who are therefore, with regard to this feature, paedomorphic when compared with adult males. For juveniles without fully erupted canines and no M3, the average distance for males (n=9) is 10.5 mm and for females (n=4) is 10.6 mm. In contrast, a statistically significant difference (p=0.00016) was found between the adult male distance (n=4, average=3.95 mm) and the adult female distance (n=10, average=8.47 mm). This cranial variable, here entitled 'opisthocranium migration,' illustrates that the developmental process of progenesis in female vervet monkeys is evinced in the morphology of the skull. Due to the consistent sexual dimorphism of this feature, it is also possible to use the degree of opisthocranium migration in adults as a tool for sex estimation in this species.

Cranio-facial variation in sub-species of *Pan*.

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Genetic evidence suggests that *Pan troglodytes troglodytes*, *Pan troglodytes schweinfurthii* and *Pan troglodytes verus* represent three different populations, with the latter possibly being a distinct species. Morphological differences, however, are not clear-cut and bear directly on questions concerning taxonomy, sexual dimorphism and phylogeny in extant hominoids and early human evolution. We re-examine *Pan* cranial variation using Procrustes-based geometric morphometrics to: 1) quantify and examine overall cranial shape variation among *Pan* species and sub-species; 2) investigate whether the face, basicranium and cranial vault can distinguish sub-species of *Pan*; this is because different regions of the cranium have shown to preserve phylogenetic information differentially.

Our dataset comprises 123 adult chimpanzees and 36 bonobos, and a total of 53 3-D landmarks. To analyze cranial shape variation, we conducted principal component (PCA) and canonical variate (CVA) analyses on Procrustes shape coordinates. The PCA of the

full cranial landmarks set shows a separation between the *Pan* species, but not the sub-species. The CVA distinguishes bonobos from chimpanzees, and also shows subtle separation among the chimpanzee sub-species. In the separate face, basicranium and cranial vault analyses, bonobos are best distinguished from chimpanzees in aspects of the face and basicranium. Among the sub-species, *P. t. verus* and *P. t. schweinfurthii* are most disparate from each other, particularly in the face. *P. t. troglodytes* consistently overlaps with *P. t. verus* and *P. t. schweinfurthii* in all three cranial regions.

These results suggest population differences between the western and eastern chimpanzees, but do not indicate consistent separation of the western chimpanzees as suggested by the genetic data.

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Is there an environmental effect on acoustic strategies of black and white ruffed lemurs (*Varecia variegata editorum*) in Ranomafana National Park, Madagascar?

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Acoustic signals convey messages about the location, behavior, and physical state of callers. Environmental factors affect vocal structure and sound transmission regardless of content. Time of day, temperature, wind speed, atmospheric pressure, and humidity affect the level of degradation and attenuation an acoustic signal endures while traveling from source to recipient. We predict that to increase the efficacy of communication, primates use acoustic signals when transmission is optimal. Therefore, call rates will vary with environmental factors.

We tested the prediction that environmental factors shape acoustic strategies of black and white ruffed lemurs (*Varecia variegata editorum*). Long calls are one of the most salient characteristics of the species, carrying over 1km. From July-August 2011 (N=544 hours), we recorded instances of *Varecia* long calls (N=172). We tested whether call rates differed across morning, mid-day or late afternoon time periods, and wet vs. dry periods (chi-square), and if call rates were associated with changes in temperature, barometric pressure and wind speed (Spearman's rho).

Contrary to our predictions, call rates did not significantly differ across time periods and were not associated with temperature, barometric pressure or wind speed (p > 0.05). However, call rates significantly differed between wet and dry periods (p<0.001). A longer study comparing acoustic strategies across seasons may reveal relationships between abiotic factors and *Varecia* long calls, or that the acoustic strategies of ruffed lemurs are more heavily influenced by social than abiotic factors. Investigation of the social

behaviors associated with calls may better elucidate the acoustic strategies of *Varecia*.

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Ontogenetic shape variation in the cranium of *Rungwecebus kipunji*.

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The cranial morphology of the endemic Tanzanian primate *Rungwecebus kipunji* is known only from juvenile specimens. Morphometric analyses of the first voucher specimen, an M1-stage male (FMNH-187122), identified similarities with *Lophocebus aterrimus* but supported the kipunji's generic status. The second voucher specimen, an M2-stage male (SHCP-2458), has undergone qualitative and phylogenetic analyses but has not been included in multivariate, morphometric studies. In this study, 3D geometric morphometrics was used to compare the cranial morphologies of FMNH-187122 and SHCP-2458. To facilitate comparisons, developmental simulation was used to estimate the M1-stage morphology of SHCP-2458, M2-stage morphology of FMNH-187122, and adult morphologies of both specimens. Objectives were to evaluate the affinities of SHCP-2458, characterize kipunji cranial development, and explore the impact of ontogenetic variation on estimates of adult morphology. Coordinate data were collected on 109 juvenile and adult-male crania representing five African papionin genera. The male developmental trajectory for each species was approximated by regression of Procrustes-aligned coordinates on dental stage. Juvenile and adult landmark configurations were simulated by application of developmental vectors to the juveniles' landmark coordinates. Affinities of actual and simulated kipunji crania were assessed using Procrustes distances and PCA. Next to FMNH-18722, SHCP-2458 is most similar to M2-stage *Lophocebus aterrimus*. Shape differences between FMNH-18722 and SHCP-2458—concentrated in the face and neurocranium—are greater than between M1- and M2-stage *Lophocebus* but similar in magnitude to *Papio*. Vectors of *L. aterrimus* and *Papio* provide the most accurate estimates of actual juvenile morphology. Affinities of simulated juveniles and adults will be discussed.

When artiodactyls lead anthropologists astray: important considerations, strengths, and limitations of comparing limb bone adaptation between artiodactyls and primates.

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Studies of adaptation of artiodactyl (e.g., sheep, deer, gazelles) limb bones are now commonly used as a means for understanding processes/mechanisms of adaptation in appendicular skeletons of primates. Benefits of

using artiodactyls include: (1) availability, (2) ease of strain gauge application on some bones, and (3) physiological and anatomical studies that have established them as experimental models for comparisons with humans (e.g., sheep). While benefits of using non-primate experimental/comparative models are clear, there are also important limitations that might not be readily apparent and could confound interpretations. In a recent book chapter (Ch. 7, *In Bone Histology: An Anthropological Perspective*, 2011; CRC Press), a systematic method is described for identifying manifestations of functional adaptation (primarily in the context of load history) in intra- and inter-specific comparisons of appendicular bones of various species. I will demonstrate how this method helps to identify strengths and limitations when considering data from artiodactyls for understanding adaptation in primate limb bones. Many examples, including important studies in the anthropological literature, will also be presented in this context. Besides obvious issues (e.g., animal size/mass, age, and gender), important considerations include: (1) importance of muscle/tendon/ligament "protection" and load sharing, and why these might evoke seemingly paradoxical modeling/remodeling events, (2) the shift from modeling- to remodeling-based adaptability at skeletal maturity, and (3) how altricial vs. precocial growth can confound interpretations, especially in terms of differences in the growth of bones that become highly osteonal more rapidly vs. those that retain larger percentages of primary histology in the adult.

Variation in mandibular condylar morphology in two Tai Forest Colobine species.

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The connections between primate mandibular morphology and dietary variation have been well-studied, but the nature of these relationships remains uncertain. Metric analysis of gross mandibular form has yielded important insights, but the internal structure of mandibular bone is not often considered. Examination of internal features, such as trabecular density and cortical bone thickness, could provide further insight since these variables may reflect modeling and remodeling activity in different loading environments.

Variation in internal mandibular condylar structure was explored using bilateral AP digital radiographs of *Procolobus badius* (n=6) and *Colobus polykomos* (n=5) from Tai Forest, Côte d'Ivoire. These sympatric colobines are similar in body size and display moderate sexual dimorphism but appear to differ in dietary habits, with *C. polykomos* presumably exploiting tougher foods. As a measure of trabecular density, mean grayscale values were taken from six areas of each condyle. In addition, the cortical thickness on the medial and lateral aspects of the condylar neck was measured.

Overall, *Procolobus badius* and *Colobus polykomos* do not differ significantly in mean

grayscale values or cortical thickness. Most of the variance in grayscale is accounted for by individual variation (41%) or sex (23%). Males tend to have higher grayscale values (i.e., denser trabecular bone) throughout the condyle, on the medial side in particular. Similarly, males exhibit significantly greater cortical thickness on the condylar neck compared to females. Whether these sex differences reflect variation in feeding ecology between males and females is currently being investigated in Tai Forest.

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Human postcranial morphology: trends in the Central European Holocene record.

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Central European (CE) Holocene is seen as the period of substantial changes in economic, social and political organization, starting from the small and flexible groups of foragers and first agriculturalists (Mesolithic, Neolithic) through secondary product revolution (Eneolithic), hierarchical settlement structures (Bronze Age) and finishing with Medieval and Historic urbanization. However, little is known about the effect of these changes on human postcranial morphology. A CE sample of 580 individuals from nine archaeological periods was analyzed here. Stature, body mass, and cross-sectional parameters of femora and tibiae were analyzed. Mean stature decreases from the Neolithic to Iron Age/Roman and increases to the Middle Ages; this observation is more prominent among males than females. During CE Holocene, male mean body mass has no temporal tendency but has higher fluctuations compared to female groups. Female mean body mass shows a slight tendency toward higher values in the later Holocene. Mean cortical area shows a light tendency toward higher values in the later Holocene in both males and females. An index of mobility (A-P/M-L bending rigidity of the femoral and tibial shafts) decreases through the Holocene; this trend is more accentuated among males. Overall robusticity demonstrates either a slight increase through CE Holocene (Zp-femora) or remains stable (Zp-tibiae) for both males and females. In conclusion, it is surprising that the impact of socio-economic changes on postcranial features was so limited through the Holocene since the majority of the described tendencies are relatively slight.

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Battle of the sexes: identifying victims of domestic abuse in the archaeological record.

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Domestic abuse is one of the sources, if not the most common source of injury for women today. It is a problem that has existed for millennia. Domestic abuse was also a problem at the post-medieval communities of Coach Lane, Tyne and Wear, and Fewston, North Yorkshire. For a problem which affects the daily life and health of women, little work has been done to identify victims of domestic abuse in past populations. This thesis attempts to remedy that situation. Victims of domestic abuse are identified based on the examination of fracture patterns of the ribs, sternum, facial bones and long bones. The fracture data is analyzed using Shannon Novak's predictive formula. Three women were identified who were most probably the victims of domestic abuse. All three of these victims came from the urban Coach Lane site. The rural site of Fewston did not have any female individuals with evidence of fractures common to domestic abuse. This perhaps suggests that domestic violence was more common in urban environments than rural environments.

Developmental instability and fluctuating asymmetry in the infant brain.

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Minor perturbations that occur during an organism's development are termed developmental instability (DI). DI is associated with subtle deviations in symmetry within structures, resulting in fluctuating asymmetry (FA). Increased measures of FA are thought to indicate heightened levels of DI. Studies of the skull in children with craniofacial anomalies have shown increased levels of FA, suggesting greater developmental instability. Sagittal craniosynostosis, the premature fusion of the sagittal suture, has been associated with increased FA in the skull. As the skull and brain develop as an integrated system, we hypothesize that levels of fluctuating asymmetry in the brain in infants with sagittal craniosynostosis are increased relative to those of unaffected infants.

Our study sample consisted of magnetic resonance images obtained from 10 infants with isolated sagittal synostosis, and 10 age-matched unaffected infants, aged 7-72 weeks. We collected 3D landmark coordinate data from

reconstructions of the brain surfaces using Amira 5.2®. We then statistically compared measures of FA between the two groups. Our results show an increased magnitude of FA in the brain in infants with synostosis overall. The greatest increase in magnitude of FA describes anteroposterior dimensions of the brain. However, we also find patterns of decreased FA, localized to measures of the height of the brain. These results suggest that craniosynostosis is associated with increased developmental instability in the brain in general, with localized regions showing greater stability than that of unaffected infants.

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Feeding biomechanics of OH 5 assessed using finite element analysis.

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The craniofacial morphology of *Paranthropus boisei* exhibits a number of highly derived characteristics that have been argued to be functionally related to feeding. These include an anteriorly-placed sagittal crest, a visor-shaped infraorbital region that extends anteriorly and laterally, a zygomatic root that arises anteriorly relative to the tooth row and extremely flared zygomatic arches that twist about their transverse axes. Together, these features are hypothesized to either decrease structural stress, increase the mechanical advantage of the masticatory muscles, or both. This study uses finite element analysis to separately test the hypotheses that the *P. boisei* cranium is structurally stronger and configured to more efficiently generate bite force than the crania of *Pan troglodytes* and *Australopithecus africanus*.

Binary stereolithography files of the external craniofacial surface, the frontal sinus, the left and right maxillary sinuses, the teeth including roots, and trabecular bone of OH5 were obtained from a recent virtual reconstruction of this specimen. Surface files were edited and meshed to produce a finite element model. The model was assigned heterogeneous, orthotropic material properties

characteristic of chimpanzee crania, constrained at the TMJs and molar and premolar bite points, and subjected to isometrically scaled muscle forces derived from chimpanzees. Von Mises, maximum principal and minimum principal strains were recorded from various locations across the cranium, as were bite forces and strain energy. The results were compared to those from comparable finite element analyses of crania of *Pan troglodytes* and *Australopithecus africanus*. Preliminary findings from these comparisons are broadly consistent with the functional hypotheses.

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Weaning and tooth emergence in a seasonal world: implications for primate evolution.

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Of any postulated relationship in life history, it seems obvious that young mammals need teeth to be weaned. Indeed, broad sketches of mammal evolution propose that lactation powers fast growth to a fixed body size; early growth of head and face allows a more limited tooth replacement; and limited replacement allows complex occlusions specialized for dietary niches (see Pond 1977). Primates are the best case within mammal evolution to show how the dentition integrates with life history.

Age of weaning is compared to ages of tooth emergence for N=34 primate species in 10 families. The simplest analysis is the most revealing: locating data relative to the line $x = y$ (log age of tooth emergence) = y (log age of weaning). Correlation and degrees of freedom (affected by range in x and relatedness) are of lesser concern.

Comparisons find that primates, on average, wean after the deciduous dentition is complete (25/26 species lie below $x=y$) and before M2 emerges (21/22 above $x=y$). Weaning nears age of emergence of the M1 when x is ca. 0.3-4 years, but not outside these limits. Weaning, a key determinant of reproductive output and lifetime fertility, not only has limits, but seasonal imperatives. Many primates keep the total cost of rearing offspring to feeding independence to ½-1 year. Comparisons emphasize the special problem of weaning infants with a limited dental battery and further suggest that species in the fossil record may distribute eruption times differently, depending on seasonality/equability in climate.

Diet, behavior and nutrition in captive western lowland gorillas (*Gorilla gorilla gorilla*): implications for chronic disease in apes and humans.

B. KATHERINE SMITH and MELISSA J. REMIS. Anthropology, Purdue University.

This work examines the discrepancies between diets and dietary adaptations among captive gorillas and humans living in post-industrial societies with an eye towards understanding the effects of fiber, tannins and a sedentary lifestyle. Recent medical research has emphasized the human health benefits of high levels of dietary fiber and tannins, likely integral parts of hominid diets. Here we examine the diet, nutrition and behavior of captive gorillas. Zoo gorillas are uniquely situated for anthropological research as their daily experiences compare to post-industrial humans with low activity levels and readily available, calorie-dense, low fiber and tannin diets. Moreover, both captive gorillas and post-industrial humans suffer from chronic diet-related diseases including obesity and heart disease. We first conducted a survey to analyze current zoo gorilla diets and found captive diets are significantly lower ($F=52.45$, $p<0.01$) in fiber and higher in calories ($T=-3.69$, $p<0.001$) than wild diets. We also introduced experimental high fiber and tannin rich diets to gorillas at the Oklahoma City Zoo. When fed their typical diets, they foraged less and rested more than wild gorillas ($x^2=31.19$, $p<0.001$) and exhibited more abnormal feeding behaviors than when fed the experimental diets ($x^2=30.62$, $p<0.001$). We expect to see improvement in health biomarkers with the experimental diets. As among humans, chronic health issues in zoo gorillas may relate to sedentary lifestyles and their low-fiber, tannin poor diets relative to wild and ancestral diets, leading us to propose the usefulness of comparative, evolutionary approaches when considering human dietary adaptations and mismatches.

This study was funded by the Ingestive Behavior Research Center, Purdue Research Foundation, and Oklahoma City Zoo.

Vindija Neandertals as evidence for gene flow from early modern humans.

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The Vindija Neandertal remains have played a critical role in discussions on the emergence of modern Eurasians and the possible involvement of Neandertals in that process. Most recently, fragments from Vindija yielded a draft sequence of a Neandertal genome revealing a 1-4% contribution of Neandertals to recent Eurasians. Morphology of the Vindija Neandertals has long been regarded as showing progressive features in a late Neandertal sample, but the interpretation of the meaning of this pattern has varied over time. Although various studies have shown the Vindija pattern is not due to any type of sample bias, that interpretation is still cited. Otherwise the morphology is seen as either reflecting the process of modern human emergence in Eurasia or as just a part of "normal" Neandertal variation. If Vindija does reflect the process of transition to modern humans, the question is how does it reflect this process? We suggest that the Vindija morphology reflects evidence for gene flow from early modern populations into Neandertals. We show how the Vindija cranial and mandibular pattern reflects that process and demonstrate that indications of mixing among stratigraphic levels

at the site do not impact biological interpretations of the Vindija sample. This direction of gene flow has not been detected in genetic studies so far. Our interpretation underscores the importance of using both morphological and genetic data in approaching questions of late human evolution.

The role of masticatory strain in the phylogenetic utility of cranial datasets in papionin primates.

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Recent studies have suggested that the quantity of strain imposed upon a cranial region during mastication may affect the degree to which it reflects phylogeny among primate species. The homoiology hypothesis states that the plastic deformation and homoplasy experienced by high strain cranial regions should render them less phylogenetically informative than low strain regions. To test this hypothesis in the Papionini, the 3D morphology of two high strain cranial regions, the palatomaxilla and zygomatic, were compared to that of a low strain region, the upper face, in 15 papionin species using landmark-based analyses. The sample was separated by sex, and each dataset subjected to Generalized Procrustes Analysis and Principal Components Analysis. PCs found to be significantly correlated with centroid size were excluded from the analysis, and a Mahalanobis distance matrix was generated of interspecific distances for each cranial region. A molecular distance matrix was calculated using published genetic data.

All three cranial datasets for each sex were found to be significantly correlated with molecular distances using a Mantel test. A Dow-Cheverud test revealed no significant differences between the degree to which the upper face reflected the molecular matrix compared to the palatomaxilla or zygomatic. Thus, there is no statistical support for the homoiology hypothesis here, since the low strain regions do not reflect phylogeny significantly more reliably than high strain regions. This result corroborates findings from previous studies using linear cranial dimensions to reconstruct intergeneric relationships, and upholds the idea that the homoiology hypothesis is not supported among catarrhine primates.

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The relationship between gestural signaling and positional behavior in chimpanzees and bonobos.

LINDSEY W. SMITH. Thompson Writing Program, Duke University.

The gestural repertoires of chimpanzees and bonobos are well documented, but the relationship between gestural signaling and

positional behavior (postures and locomotion) is unresolved. This study examines how gestures and positional behavior shape each other and how this relationship varies across two closely related species in similar environments. From September 2007 to June 2008, 500 hours of video data were collected from four groups: chimpanzees at the St. Louis Zoo and Los Angeles Zoo, and bonobos from the San Diego Zoo and San Diego Wild Animal Park. 2,041 chimpanzee gestures and 3,486 bonobo gestures were recorded and coded in terms of the positional behaviors of the actors.

Chimpanzees gestured most frequently while sitting (35.5% of total gestures), while bonobos gestured most frequently while lying (24.0% of total gestures). Both species also gestured frequently while bipedal (10.7% of chimpanzee and 11.2% of bonobo gestures), though 95.3% of these gestures were produced by infant bonobos. Adult chimpanzees gestured more while bipedal than adult bonobos, but these gestures were rarely manual gestures involving the upper limbs. Rather, positional behaviors were often incorporated into the communicative acts. For example, among adult male chimpanzees, the gesture "bipedal swagger" (involving piloerection and exaggerated swaying) accounted for 74.3% of the gestures produced while bipedal walking. These results reveal a complex interplay between gestures and positional behavior, but provide little evidence that bipedality facilitates manual gesturing. Understanding this relationship is crucial for testing theories about human language origins, particularly whether bipedality prompted increased manual gesturing in early hominins.

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Reassessing enigmatic Asian hominoid dental remains.

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Scholars frequently debate the taxonomic status of isolated Asian Pleistocene teeth, which is complicated by morphological and metric convergence between fossil orangutan (*Pongo* sp.) and *Homo erectus* molars. Moreover, fossil

Pongo was widely distributed throughout mainland Asia and Indonesia, showing remarkable dental variation. In order to clarify the occurrence and abundance of Asian hominins, we non-destructively examined 2D relative enamel thickness and distribution, enamel-dentine junction shape, and/or the developmental long-period line periodicity in 30 teeth from the Chinese Apothecary collections (11 "*H. erectus*," 19 "*Hemantropus peii*") and 7 teeth from Sangiran Dome (either *H. erectus* or *Pongo*). These were compared to 10 definitive *H. erectus* teeth from Sangiran, Zhoukoudian, and Trinil, and more than 170 fossil *Pongo* teeth. All teeth were imaged with laboratory grade and/or synchrotron micro-computed tomography. While *H. erectus* and fossil *Pongo* show some overlap in relative enamel thickness values, fossil *Pongo* molars show a more uniform distribution across the enamel cap than *H. erectus*. Molar enamel-dentine junction shapes are also fairly distinctive, with fossil *Pongo* showing relatively shorter dentine horns than *H. erectus*. Long-period line periodicity values are markedly higher in fossil *Pongo* than in *H. erectus*, as are postcanine crown formation times. We find that the majority of the teeth assigned to "*H. erectus*" show greater affinity to orangutans than to *H. erectus*. Moreover, the "*Hemantropus peii*" sample is indistinguishable from fossil *Pongo*. These results suggest that hominins may have been less common in certain Asian faunas than has been previously appreciated.

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Relative eye size at birth in strepsirrhines and *Tarsius*: life history correlates and growth patterns.

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Primates have large eyes relative to head size. Based on studies of humans and macaques, eye growth is described as most rapid in prenatal and early postnatal ontogeny. To better understand the pattern of eye growth across the primate order, we measured transverse eye diameter (TD) in thirty-eight infant primates (17 strepsirrhine species and *Tarsius syrichta*). Data were used to investigate the proportional size of the eye (using ratios and residuals) among primates, and to examine the correlation of TD with life history variables. Most variables were strongly correlated with cranial length (CL), and residuals from CL ("relative TD") were calculated with least squares regressions. For most species, the infant TDs are more than half of published adult values, suggesting that a substantial amount of growth in diameter occurs prenatally. Two exceptions include *Nycticebus*

and *Tarsius* (infant/adult TD ratios are 0.33 and 0.44, respectively). Relative TD is uncorrelated with relative body mass (residuals of perinatal relative to adult body mass), but is significantly ($p < 0.005$) correlated with relative gestation length ($R=0.67$) and relative weaning age ($R=0.56$). However, when phylogeny is considered (PGLS), only the correlation with relative gestation length remains significant. Our findings reveal relative perinatal eye size is positively correlated with relative gestation length. In this sense, TD growth follows a pattern of brain growth in primates. Moreover, the majority of growth in TD occurs prenatally for most primates. In *Nycticebus* and *Tarsius*, however, eyes grow less prenatally and compensate with a greater extent of postnatal growth.

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An evaluation of medical imaging techniques for craniometric data collection.

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The acquisition of direct anthropological measurements from human remains is sometimes difficult when dealing with freshly deceased or recently recovered individuals (i.e., mass burials). Maceration of these remains raises ethical, cultural and religious issues, and, in the United Kingdom, is in conflict with the recommendations of the Clarke enquiry. The advent of modern digital imaging techniques offers alternative methods for gathering anthropological data non-invasively.

Here, we evaluate the viability of two modern imaging methods; Multi-Detector Computed Tomography (MDCT) Scanning and Computed Radiography (CR) for recording cranial measurements to aid human identification. Twenty skulls from a museum collection were examined using both MDCT and CR. Five standard measurements were taken from each cranium using both techniques. These measurements were compared with direct physical measurements taken using digital sliding and spreading calipers.

The results indicate that measurements taken from CT scan images were as accurate as direct osteometric measurements, while measurements taken from CR images were affected by magnification proportional to the distance of the anatomical landmark from the image receptor. It is recommended that CT images should be used as the method of choice for taking craniometric measurements from fleshed remains, and an accurate and reproducible magnification correction method must be applied for CR imaging if this is the only option. Improved methods and portable technology will have legal, forensic, and morphometric applications, and refine and improve field identification methods.

Acculturation, chronic psychosocial stress, and health among Latino mother-child pairs in Texas.

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Chronic psychosocial stress is an important link between challenging social environments and negative health. Despite the persistence of health disparities among US minority populations, little is known about the effects of chronic stress on health among Latino populations. Recent methodological advances now allow researchers to use minimally-invasive techniques to measure several physiological parameters associated with psychosocial stress. This study presents results from the pilot study Latino Youth and the Future, which examined stress biomarkers related to immunity (Epstein-Barr Virus [EBV] antibodies and C-reactive protein [CRP] from dried blood spot samples) and neuroendocrine function (salivary alpha-amylase [AA]) among Latino mother-child pairs in Houston, Texas. We focus on associations between stress biomarkers and stressors such as acculturation, discrimination, length of residence in the US, and occupational stress. This study used a multi-method, multi-agent design with structured interviews, questionnaires, videotaped interactions, anthropometrics, and biomarker collection among 40 Latino mother-child pairs, including 40 eighth grade children (20 boys, 20 girls) primarily of Mexican descent.

We documented several significant correlations between different biomarkers and psychosocial stressors, notably between EBV antibodies and time in the US, language ability, and acculturation among mothers. We also documented a significant correlation between baseline AA in mothers and kids; however, in response to the interaction task, AA levels stayed higher in mothers compared to their children. This study shows how different stressors can elicit different physiological responses, and demonstrates that simultaneous measurement of multiple stress biomarkers is required for a complete understanding of the effects of stress on health.

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The relationship between Body Mass Index and tuberculosis: evidence from the English archaeological record.

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Poor macronutritional status and low body mass index (BMI) has been identified as a major predisposing factor and/or associating complication of tuberculosis in clinical literature.

This study has attempted to determine whether this positive relationship between tuberculosis and poor macronutritional status exists in the archaeological record. **Hypothesis:** A statistically significant difference should exist between the body mass indices of individuals from archaeological record with skeletal evidence of tuberculosis and a sample of age and sex matched controls from the same populations. **Materials and Methods:** Fifty-eight individuals from six medieval and post-medieval English archaeological sites were subjects of this study. Body Mass (Ruff et al. 1991, Grine et al. 1995), stature (Trotter and Gleser 1957), and BMI (Quetelet 1849) were assessed for pathological and control individuals. An independent t-test was conducted for the mean BMI of each category to determine significance. **Results:** Independent t-tests for pathological and control individuals showed no significant difference in mean BMI at the 95% confidence level. **Conclusion:** This study was unable to provide supporting evidence for a relationship between tuberculosis and low BMI and the hypothesis was rejected. The author recommends that future research in this area focus on increasing the overall sample size, using collections with documented causes of death for a more substantial diagnosis in pathological and control individuals, and employing more sensitive methods of body mass estimation such as combined stature and bi-iliac breadth (Ruff 1994).

The Mis Island Medieval Nubian Skeletal Collection at Michigan State University.

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The Mis Island Medieval Nubian Skeletal Collection is part of a large-scale rescue archaeology project coordinated by the British Museum and Sudan Archaeological Research Society to mitigate the loss of cultural history due to dam construction on the Nile in Northern Sudan. Mis Island, located in the Fourth Cataract of the Nile, was occupied from the Meroitic period to modern day, however the sample represents remains excavated from two Christian medieval cemeteries dating to c. 6-15th centuries AD.

Cemetery 3-J-11, in use for the entire medieval Christian period, provides a large diachronic sample of a medieval Nubian population. A total of 282 individuals were recovered: 135 juveniles and 147 adults (69 females, 62 males, 16 undetermined). Cemetery 3-J-10 was a separate bounded cemetery in use during the late medieval Christian period. A total sample of 126 individuals was recovered: 50 juveniles and 76 adults (35 females, 38 males, 3 undetermined).

An extensive research initiative is currently underway at Michigan State University to fully document this unique skeletal collection. Skeletal inventories, paleopathological analyses, dental examinations, and postcranial metric data have already been assessed. Anticipated research trajectories include analyses of degenerative joint disease, patterns of activity, trauma, non-metric inherited traits, and cranial morphometrics and migration studies. Radiocarbon dating of the

remains, isotopic indicators of diet, and ancient DNA studies are also anticipated. The expected goal of this research is to present a profile of life in the community at Mis Island and provide a regional comparison to other medieval Nubian collections.

Ranging patterns of red langurs (*Presbytis rubicunda*) in East Kalimantan, Indonesia.

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Red langurs (*Presbytis rubicunda*) are endemic to the island of Borneo and are distributed widely throughout the island. However, aside from a few short-term studies, little has been reported about the behavioral ecology of this species. Although variable patterns of ranging and possible fission-fusion sociality were suggested by previous studies this has not been confirmed through further research. Here we report preliminary data on the ranging patterns of red langurs from a newly established field site in the Wehea Protected Forest in East Kalimantan, Indonesia (01°32'46"N, 116°46'43"E). Data were collected from a single habituated group consisting of 11 individuals (1 adult male, 3 adult females, 1 subadult male, 3 subadult females, and 3 juvenile males). Data were collected through follows each month between January-July 2011 (n=650 hours). GPS coordinates and group scan data collected every 15 minutes were used to assess ranging patterns and group cohesion and spread. We found that the study group had a home range of ~72 ha that appeared to overlap considerably with the home ranges of at least two other groups of red langurs. We observed 11 occurrences in which the study group split into two distinct subgroups separated by >300m that traveled and foraged independently for at least 1 hour, and on at least two occasions slept in separate locations. These fission events and the generally low levels of group cohesion observed may be a response to resource competition and overall low availability of resources in Borneo generally and East Kalimantan in particular.

This research was supported by Primate Conservation, Inc., the University of Wisconsin-Oshkosh, and the University of Southern California.

Back from the dead: an osteobiography of a depression era miner from central Nevada.

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In 2010, an excavation in central Nevada thought to be a privy turned up a human burial instead. Based on features of the cranium and pelvis, the individual was classified as male. Although edentulous, the innominate suggested an age of early 40s. FORDISC results were equivocal, suggesting white, Japanese, or

Egyptian. A small hole (.272 mm) on the right temporal counter-balanced by an exit wound on the left parietal was considered the likely cause of death. aDNA analysis shows the individual was K haplogroup with HVI polymorphisms at 16224(T), 16311(C), and 16320(T), consistent with European or Middle East ancestry. After sleuthing records in central Nevada, the death certificate of this 'unknown miner' was found. It provided a name (Floyd), birthplace (Illinois), birth date (11/7/1893, age 44 y, 8 m), and noted 'suicide - bullet in head.' Not only were methods validated but the skull was subject to rapid prototyping at the Berkeley Lawrence laboratories for a complete three-dimensional reconstruction. Floyd, who endured a hard scrabble existence and ended his life by suicide, now enjoys fame in death that eluded him in life.

"Leading" bones in the degenerative joint disease scoring: evaluation of the consistency of using incomplete joints in an archaeological sample.

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The archaeological skeletal sample of the Imperial Roman necropolis of Porta Marina at Velia (Italy, I-II cent. AD) consists of more than 300 skeletons with a mortality profile which fits the Coale and Demeny west female model 1 and it is characterized by an exceptional preservation state. On the adult sub-sample (N= 102), we carried out the degenerative joint disease analysis (DJD), taking into account shoulder, elbow, wrist, hip, knee and ankle. While it is known that within the same joint the single bone ends show different level of affection, the preservation of archaeological remains often preclude the recovery of complete joints. This consideration led us to perform an investigation aimed to quantify the effective informative value, on an archaeological sample, of the scoring procedure customarily adopted in the relevant literature. The results confirm that differences in bones in a given joint complex show that one element is more consistently affected. For example, in the shoulder joint the scapula glenoid fossa and the humerus proximal epiphysis show the same level of affection in 55% of the cases while the glenoid fossa is a better DJD predictor in 39% of the cases. In the elbow joint, the ulna is definitely the "leading bone" in the DJD recording, showing the highest scores in 53% of the cases. Thus the presence of the most informative bones for each joint is a primary condition in order to achieve a more realistic picture of DJD at both individual and population level.

Secular change in Hispanic crania.

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Craniofacial secular change has been documented in the American Black and White

population identifying vault height as the variable most positively correlated with time (Jantz 2001; Jantz and Meadows Jantz 2000; Wescott and Jantz 2005). Recently, a demographic shift has taken place in the U.S. with an increase in Hispanic individuals. Secular changes in Hispanic skeletons have not been documented in the U.S., largely due to the lack of documented collections with significant numbers of Hispanic individuals (Spradley 2008). Due to large scale data collection efforts between the Pima County Office of the Medical Examiner (PCOME), The University of Tennessee, and Texas State University to systematically collect metric data on migrant deaths at the PCOME, data from Hispanic individuals are now available for study.

The excavation and analysis of Tucson's oldest and largest Hispanic cemetery, allows for the opportunity to study cranial secular change between historic and recent Hispanic groups. The cemetery, in use between 1862 and 1875, represents Tucson's Mexican and Mexican American population of the time (N=60). The PCOME sample (N=92) represents individuals born primarily during the mid-20th century, the majority (over 90%) are from Mexico.

Based on univariate analyses, vault height has not increased over time. Vault height has been suggested to correlate with stature (Jantz and Meadows Jantz 2000) and previous studies of secular change in height have found negligible differences in stature throughout Mexico (López-Alonso and Condey 2003). The results will be discussed within the framework of population structure and history of both groups.

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Linking GPS data with behavior to study the travel ecology of the Japanese macaques of Yakushima Island, Japan.

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Behavioral GIS analysis is becoming part of the standard analytical tool kit for primatologists, made possible by the routine use of GPS devices during fieldwork. In this study, the activities of focal animals were linked to locations fixed at high frequency with a GPS carried by the field researcher while closely following female Japanese macaques (*Macaca fuscata yakui*) of Yakushima Island, Japan. We present results here on three analyses carried out with this dataset on the travel ecology of the monkeys. We mapped the locations where the focal animals fed, groomed, walked, and paused to sit, to confirm that home range use varied by activity. By constructing travel routes from the GPS fixes, we mapped the daily travel of focal animals with the animals' activities carried out along that route to visualize feeding and grooming sites during each day. Travel segments between key features varied greatly in distance,

speed, and route shape in travels between different locations and activities. Researchers have many choices in constructing travel routes to analyze monkey travel at various spatial and temporal scales using different combinations of focal animal activities, time intervals, and filtering techniques to mitigate GPS fix variability. While we consider the GPS-derived travel data to be generally very accurate, there is a need for researchers to standardize methods or explicitly declare methods when presenting spatial data to obtain consistent results comparable among different studies even at a single study site, especially for route distance, which is sensitive to how routes are constructed.

Does the primate pattern hold up? Testing the functional significance of infraorbital foramen size variation among marsupials.

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The infraorbital nerve, which passes through the infraorbital foramen (IOF), provides sensory innervations to the upper lip, face and vibrissae. The IOF has been used to interpret the ecology of extinct primates for several decades. In primates, relative IOF area covaries with diet, where frugivores have relatively larger IOFs than folivores or insectivores. Currently, it is unknown if the above described ecological pattern holds outside the primate order. Here, we examine how relative IOF area varies across marsupials occupying different ecological niches. Marsupials were chosen because they converge with primates in both ecology and morphology. IOF area and cranial length were collected from 41 marsupial species to generate a measure of relative IOF area. An ecological profile (diet and substrate preference) was created for each marsupial sampled and each was classified as a faunivore, folivore, fungivore, frugivore, or graminivore and as either terrestrial or arboreal. Results show relative IOF area did not vary significantly between terrestrial and arboreal species. However, relative IOF area differed significantly by diet category ($p = 0.019$). Species that specialize in feeding on non-grassy leaves have significantly smaller relative IOF areas than species which primarily feed on grasses, insects, vertebrates, or some combination thereof. Behavioral analyses for a subset of the folivores in this study suggest that this difference is due to a greater reliance on hands for feeding. These results, combined with earlier work in primates, suggest that relatively small IOF area may reflect increased reliance on hands in relation to diet, but not substrate.

Excavations of St. George's Caye Cemetery, Belize.

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St. George's Caye is remembered in Belizean history not only for the pivotal role it played in securing independence from Spain in the late 1700s, but also because it informally acted as the first capital of the nation. Over 200 years later, very little is known about the small group of buccaneers-turned-logwood cutters that inhabited the caye during the 18th and 19th centuries. The St. George's Caye Archaeological Project was initiated in 2009 with the goal of uncovering information regarding early settlers' lives.

St. George's Caye Cemetery is dated to approximately the 18th century and the 2011 excavations recovered 18 individuals. Thirteen of the burials excavated contained one individual each, while an additional four burials were partially commingled, either by natural forces or human intent. Skeletal preservation of the site was impressive and most burials included elements of both the appendicular and axial skeleton. Sex and age estimates for individuals were based on morphological and metric analyses. Individual age-at-death estimates range from sub-adult to older adult, with middle adults being the most widely represented at 50.0%. Additionally, 46.7% of the adult sample was estimated as male, 13.3% as female, and the remaining 40.0% were indeterminate. The high percentage of indeterminate and male estimations coupled with the low percentage of females could indicate low levels of sexual dimorphism among the sample. Hypoplasia was evident in 92.3% of individuals with adhering dentition. Associated artifacts included coconut-shell buttons, a candle snuffer, a silver coin, and a metal coffin plate containing identifying information.

An integrative approach to understanding primate mating systems: oxytocin and New World monkeys.

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The oxytocin (OT) neuropeptide system is consistently implicated in the formation and maintenance of social bonds across species. OT and oxytocin receptor (OTR) amino acid sequences are highly conserved across Mammalia, with identical amino acid sequences reported for OT from marsupial mammals to humans. We examined protein coding and noncoding, putative *cis*-regulatory sequences of OT and OTR in primates. For protein coding sequences, we find that New World monkey (NWM; Platyrrhini) species have acquired novel OT and OTR amino acid replacements in a lineage-specific manner. For putative *cis*-regulatory sequences (identified using phylogenetic footprinting), we find that NWM exhibit lineage specific modifications of blocks of noncoding sequences that are otherwise conserved in non-platyrrhine primates and non-primate mammals. To better understand the complex and mosaic evolution of monogamy in primates, we have reconstructed the evolutionary history and interaction of seven traits including pair-bonding, paternal care, and duet

vocalizations using phylogenetic methods (Mesquite 2.74). Using this analysis we propose a sequential pattern of trait emergence in the evolution of monogamy in NWM and other primate groups. This framework provides insights into the origin and behavioral maintenance of the unique evolutionary trajectory of the OT neuropeptide system in NWM.

Assessing relatedness within and among groups of Bolivian tamarins using several microsatellite loci.

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Tamarin monkeys live in small social groups, often comprised of several related individuals. Relatedness values within a group indicate whether a particular group is comprised of family members or new immigrants, while those between groups indicate the degree of gene flow. This study presents results obtained by genotyping five sympatric social groups of Bolivian tamarins and supplements an ongoing behavioral study of the same population. Four social groups of saddle-back tamarins (*Saguinus fuscicollis*) and one group of red-bellied tamarins (*S. labiatus*) are genotyped and compared. DNA was extracted from hair samples of 33 individuals and amplified at 13 microsatellite loci across the nuclear genome. Relatedness values between groups are compared using Genetic Analysis in Excel (GenAlEx), while those between individuals are estimated and compared using COANCESTRY. Further studies of this and other populations are warranted, genotyping a greater number of individuals and using a wider array of microsatellite loci.

Paleoclimatological reconstruction using $\delta^{18}\text{O}$ analysis in incremental sections of human dentine: a preliminary study using a catastrophic cemetery sample.

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Understanding paleoclimatological change is an overlooked approach in archaeology to interpreting past cultural adaptations. Although stable oxygen isotope analysis ($\delta^{18}\text{O}$) is gaining popularity in the bioarchaeological community as a technique for understanding patterns of mobility and weaning, no studies have adequately demonstrated the viability of using human remains as a proxy for climate change. The East Smithfield Black Death Cemetery (MIN86) in London, England provides a unique opportunity for climate research, as the individuals interred belong to a catastrophic assemblage with a narrow, well-documented date range (1348-1350 C.E.). The beginning of the Late Middle Ages is documented by

contemporary sources as experiencing disastrous weather patterns that caused the Great Famine (1315-1317 C.E.) and predated the arrival of the Black Death to London in 1348.

In this study, a methodology is adapted and tested to measure $\delta^{18}\text{O}$ in incremental sections of dentine from the permanent teeth of eight individuals. Sections of dentine (n=116) from eight maxillary canines and two mandibular third molars provide isotopic values in which diachronic shifts in mean surface temperature ($^{\circ}\text{C}$) can be observed. $^{87}\text{Sr}/^{86}\text{Sr}$ and $\delta^{18}\text{O}$ from the enamel provides comparative data. Problems regarding contamination, timescale resolution, and the introduction of error when converting $\delta^{18}\text{O}$ to $^{\circ}\text{C}$ are discussed; solutions for these problems are proposed. This pilot study demonstrates that short-term climate change can be inferred using incremental section of dentine as a paleoclimatological proxy, and highlights the potential uses of this isotopic technique for future research.

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Developmental instability in the Down syndrome face.

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Down syndrome (DS), resulting from Trisomy 21 (Ts21), is a common live-born human aneuploidy. The phenotypic expression of Ts21 produces variable, though characteristic, facial morphology. It has been argued that Ts21 phenotypes result from amplified developmental instability (DI), a disruption of developmental homeostasis from cumulative small dosage effects of many genes. Based on this argument, DS facial features should exhibit more fluctuating asymmetry (FA, a measure of DI) than typical faces, and patterns of FA should reveal which facial regions are most affected during development. To address this hypothesis, we acquired a sample of 3D facial images (N=220) consisting of DS individuals (n=55), their siblings (n=55), and unaffected sibling pairs (n=110), aged 4-12 yrs. 3D coordinate data from 20 landmarks were used to estimate asymmetry of all bilateral linear distances of the face. A nonparametric bootstrapping procedure was used to test for local differences in FA of facial features between each sibling sample after correcting for size differences. We compared the DS sample to their siblings. The unaffected sibling sample was divided into two samples age-matched to the DS and DS sibling sample, and we compared the two samples to each other. We then compared the differences from each comparison. Our results suggest that facial

features are affected differentially in the DS sibling sample as evidenced by more statistically significant differences in FA across the face and larger average values of FA. These results lend support to the amplified DI hypothesis, and provide evidence of how DI changes across the face.

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What can radiology contribute to paleopathological examinations of juvenile scurvy?

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In recent years an increasing number of cases of juvenile scurvy have been reported and contested in the paleopathological literature, furthering debates about the possibility of identifying this dietary disorder among past populations. Despite the increasing number of reported cases of juvenile scurvy there remains a distinct lack of accompanying radiographic evidence, a method that is used to diagnose this disorder in living individuals. The notion of using radiography for assessing paleopathological cases of juvenile scurvy has been discussed by a number of researchers, yet has seen little actual implementation. Despite potential limitations, there is evidence to suggest that in circumstances of sufficient preservation and skeletal representation that radiography can serve as an excellent accompanying method to current macroscopic approaches. The use of radiography would allow for comparisons of paleopathological and clinical aspects of this disorder, with the hope of enabling more enlightened assessments of juvenile scurvy in the past. This poster will provide a critical review of the benefits and limitations of radiographic approaches to paleopathological assessments of juvenile scurvy before addressing a case study of several sub-adult individuals from Stymphalos and Zarakia, Greece, who were identified as exhibiting multiple classical macroscopic lesions of juvenile scurvy. The association of these macroscopic lesions with scurvy was further confirmed radiographically based on the observation of Wimberger's ring, white line of scurvy and metaphyseal radiolucency, three key clinical signs of juvenile scurvy. Such results suggest significant potential for the future use of radiographic imaging in paleopathological investigations of juvenile scurvy.

This study was funded by the University of Alberta, the Social Sciences and Humanities Research Council of Canada (SSHRC) and the Wiener Laboratory of the American School of Classical Studies at Athens.

The Multiple Travel Paths method: a new method for estimating daily travel distance in arboreal, group-living primates.

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In primate studies, daily travel distance (DTD) is often estimated in order to calculate energy expenditure or test foraging hypotheses. For arboreal, group-living species, the Center of Mass (CM) method is traditionally used to measure DTD; a point is marked at the group's perceived center of mass at a set time interval or upon each move, and the distance between consecutive points is measured and summed. For groups taking multiple travel paths, this method creates a central path that can be shorter than the individual paths and/or traverse unused areas. To address these issues, I designed and tested the Multiple Travel Paths (MTP) method in three groups of *Udzungwa red colobus* monkeys (*Procolobus gordonorum*) each with 33-43 individuals; DTD is calculated by recording all travel paths taken by the group's individuals, weighing each path's distance based on its proportional use by the group, and summing the paths' weighted distances. DTD was calculated using each method for a random sample of 30 days. (Full-day focal follows were conducted between April 2009 and March 2010). DTD was on average 132 meters (12.5%) shorter using the CM method (mean DTD: MTP = 1064 ± 335m; CM = 932 ± 303m), a significant finding (repeated measures ANOVA, $df = 29$, $F = 59.3$, $p < 0.00001$). Compared to the CM method, the MTP method provides consistently longer estimates of DTD that are more representative of the actual distance traveled by an entire group, providing greater accuracy for testing ecological and foraging models.

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The determination of homicide vs. suicide in gunshot wounds.

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When examining a set of human skeletal remains in a bioarchaeological or forensic context, the assessment of perimortem trauma, as well as the collection of evidence that can be utilized to determine the cause and/or manner of death are just a couple of the critical objectives facing a biological/forensic anthropologist. When evidence of perimortem gunshot wound trauma is evident in a set of human remains the question needs to be asked as to how the decedent obtained that trauma, i.e., accident, suicide, or homicide. In most situations involving homicidal gunshot wound trauma, it is difficult to determine whether the decedent was truly a victim (non-participant in a conflict) or a perpetrator of violence shot in the course of a conflict (justifiable homicide). The presence of ligatures, blindfolds, etc. may aid in those distinctions, otherwise each individual dying from a gunshot wound is a "victim" to a varying degree. A similar point of potential confusion and difficulty is found in recognizing suicidal versus homicidal gunshot wounds in certain situations. In many cases, the context of the remains and the scene will aid in the determination of suicide versus homicide. This poster will illustrate these points and provide examples of how to distinguish homicidal versus suicidal gunshot wound trauma through the use of actual forensic cases and human skeletal

remains recovered from mass graves in Bosnia-Herzegovina, resulting from the civil war in the former Yugoslavia.

Form variation in the human knee joint: a geometric morphometric analysis of variation in the distal femur and proximal tibia in thirteen distinct populations.

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The high weight-bearing function on a relatively unstable joint would suggest that the knee (here comprising the distal femur and proximal tibia) is potentially subject to the greatest degree of localised stress and remodelling in the human skeleton. In addition, stress on this joint is highly idiosyncratic, implying that population specific differences are less likely to be found in this region of the skeleton than any other. Despite this supposition, this research, which uses geometric morphometric techniques and data from 387 right sided distal femora and 370 proximal tibiae from thirteen distinct worldwide populations has found population specific differences in shape in both bony elements of the joint at a high level of statistical significance. All Mahalanobis's distances generated between samples are significant at $p < 0.0001$, with cross-validation showing the mean percentage assigned to the correct groups at 94.53% (femur) and 89.75% (tibia). In contrast to cranial morphology, which is strongly influenced by genetic affiliation, morphological differences in knee joint form between groups largely arise through differences in the physical environment. Analyses producing such data can therefore provide additional information on environmental conditions prevailing in a population's past history. Climatic variables such as ambient temperature, specifically cold winter temperature, and rainfall are shown to strongly influence morphology. Altitude, working environments and the use and type of footwear are also significant factors. Initial results also suggest that infection rates and compromised nutrition may also be influential.

The gluten "addiction": for the love of bread and pasta.

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The seed storage proteins of wheat (e.g., gluten), rye and barley can trigger celiac disease (CD) and gluten sensitivity (GS) in genetically susceptible individuals. The increasing ubiquity of gluten in prepared foods and nonfood products may partly account for the rise in the prevalence of CD and GS since the 1950s. Undiagnosed individuals with CD have an increased risk of morbidity and mortality which can be alleviated by a gluten free diet (GFD). Few adhere fully to a GFD and we believe that

the expense and inconvenience are insufficient reasons for the reluctance to give up wheat.

Participants with gluten-averse conditions (mostly CD) (39 F, 4 M) were surveyed regarding symptoms before and after diet, compliance, and family reactions. The sample (39 F, 4 M) was unusual in that 98% of participants had some college and were older (Mean = 58.1 ± 2.2 years). Participants indicated that family members do not want to be tested and few households of affected individuals are fully GF. We argue that adherence to GFD is a challenge because: 1) 86% of the participants continue to have symptoms after observing a GFD and most affected individuals have no apparent symptoms so no clear reason to change diet; 2) many patients and health care personnel are ignorant about the necessity of GFD; and finally, 3) there are longstanding cultural traditions that reinforce both the desire for and agricultural practices that breed for wheat products with qualities that make for better breads and pastas ("comfort foods").

Intraskeletal variability of relative cortical area.

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Histomorphometric and cross-sectional geometric studies of bone provide valuable information about age at death, behavioral and activity patterns, and pathological conditions for past and present human populations. While considerable exploratory and applied research has been completed using histomorphometric and cross-sectional geometric properties, the effects of intraskeletal variability have not been fully explored. The purpose of this study was to determine whether intraskeletal variability exists in relative cortical area values. To examine intraskeletal variability, cross-sections of the femur, tibia, fibula, humerus, radius, ulna, and rib when present, were examined from a cadaveric collection (n=34). The null hypothesis that the relative cortical area values of all bones are the same was tested. Statistical analysis ($P < 0.0001$) revealed that intraskeletal variability is present in the bones of these individuals, demonstrating that there is no universal relative cortical area value for a given individual. Subsequent groupings of bones (e.g., the femora and tibiae of all 34 individuals) were analyzed to determine if any bones produced homogeneous relative cortical area values. Results suggest that the only bones that produce reasonably homogenous values in this sample are the fibula, radius, and ulna. Relative cortical area values produced from other bones appear to be more heterogeneous than the values from the aforementioned bones. The biomechanical environment may play a role in the observed heterogeneity. This study is a contribution to the larger work that needs to be performed to quantify the intraskeletal variability of histomorphometric properties before variability between individuals and populations can be fully understood.

A method to estimate the timing of linear enamel hypoplasia for Neandertals.

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During childhood, systemic physiological stresses such as illness, disease, and malnutrition can disturb the growth of dental enamel. These disruptions are often recorded in the form of linear enamel hypoplasia (LEH). Many researchers have analyzed the frequency and timing of LEH formation in Neandertal populations as they relate to ideas about Neandertal living conditions, nutrition, and foraging efficiency. Previous age estimates for Neandertal LEH were largely based upon modern human dental growth standards. However, recent studies provide a more complete picture of Neandertal tooth formation. We used data from these studies to create enamel growth charts for four Neandertal anterior tooth types (upper central and lateral incisors, upper and lower canines), which are analogous to those created for modern humans by Reid and Dean (2000). The Neandertal charts differ from modern humans in the average age span encompassed by enamel formation and in the duration of enamel formation within equivalent divisions of crown height. These differences result because Neandertal teeth initiated at earlier ages, have shorter cuspal enamel formation times, have lower average long-period line periodicities (mode 7 and 8 days), and exhibit a more uniform distribution of perikymata across their enamel surfaces. Based on these new charts, we aged a series of Krapina Neandertal defects calculated from both modal long-period periodicities. The median ages at defect formation across different anterior tooth types range from 2.3-2.5 (7-day periodicity) to 2.6-2.8 years (8-day periodicity), suggesting that Neandertals experienced physiological stress earlier in life than previous estimates derived from modern human standards.

Three dimensional quantification of upper limb bilateral asymmetry among modern humans and great apes.

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Analyses of archaeological human remains and modern athletes have demonstrated a correspondence between levels of directional asymmetry in upper limb bone diaphyses and lateralized limb function. In humans, greater diaphyseal rigidity in the dominant limb is common. The first study of long bone bilateral

asymmetry among chimpanzees (Sarringhaus et al. 2005) identified a different pattern: approximately 70% of adults featured more rigid right hand second metacarpal diaphyses, while a similar proportion of individuals displayed more rigid left humeri. This likely reflects the differing influences of both manipulatory and postural behaviour on chimpanzee skeletal structure. The current study demonstrates a consistent pattern of greater mid-diaphyseal rigidity in the right upper limb bones among a wide range of human populations. While right hand dominance appears to be characteristic of all populations, between 17 and 37% of individuals within populations show more robust diaphyses of one or more left elements. To investigate interspecific patterns of asymmetry, we used 3D laser scanning to estimate bone rigidity at 1% intervals along the diaphyses of clavicles, humeri, ulnae and radii for *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus*, and *Homo sapiens*. The results suggest that within humans, a pattern of consistent directional asymmetry exists throughout the limb. The limbs of Gorillas show the lowest levels of bilateral asymmetry, while *Pan* and *Pongo* have greater and more variable directional asymmetry throughout the limb. This demonstrates that whole limb patterns of asymmetry differ between species, and appear to be influenced by activity and locomotion.

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Quantifying morbidity and quality of life in the Prehispanic Southwest.

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This study explores the lived experience in prehistoric Southwestern communities through the quantification of ill health and differential health. While mortality and fertility have profound demographic consequences on small populations, the social and economic costs of nonfatal conditions are crucial aspects of quality of life and probably of the duration of a community. As recognized by the World Health Organization (WHO), departure from good health in the short or long term comprises a substantial portion of the burden of disease. Disability Weights, one of the metrics developed by the WHO Global Burden of Disease Study, are used here to quantify the burden of injuries and illnesses documented in the skeletal and paleoparasitological records in Southwestern bioarchaeology.

Quantification of the burden of nonfatal and chronic conditions including advanced osteoarthritis, nutrient deficiencies, tuberculosis, non-venereal treponematosis, parasitism, and the sequelae of accidental and intentional traumatic injuries reported in skeletal assemblages from San Cristobal, Hawikku, Arroyo Hondo, Canyon de Chelly, Ridges Basin, and other sites moves beyond the paleopathology prevalence data and offers a more grounded perspective on the quality of life between birth and death in these communities, and perhaps a better understanding of the range of the social and biological forces stimulating small and large scale migrations in this region.

Classic Maya warfare and human skeletal trophies: victims and aggressors.

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There are many mysteries about Classic Maya warfare. It is not clear what was the scale of individual battles and strategies, who were the fighters from the various polities, etc. What does seem to be clear is its importance to rulers and elite males, because of the information archaeologists have gleaned from iconography and the Maya writing system. The taking of captives and skeletal trophies are clearly indicated, as is the praise given to successful warriors. Bioarchaeology can definitely identify skeletal trophies, as well as sometimes, the victorious warrior. Using data from Copan, Honduras, and the Sibun Valley, Belize, several cases of an important interment and associated skeletal parts from another individual are described, as well as evidence of trophies not associated with another interment but with a house for young elite men (warriors in training?). The individual traits deducible from the skeletal elements of both victims and aggressors show that only males are involved but age can vary widely, information that helps answer some questions about Classic Maya warfare.

Funding for the Copan osteological study has come from the World Bank, the Fulbright Foundation, and the University of Houston. Permission for the study is given by the Instituto Hondureño de Antropología e Historia.

Secular change in the cranial modules of white American males: 1830-1978.

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Brain size is positively correlated with stature and body mass (Beals et al. 1984). Secular increases in stature and body mass have been detected in Americans over the past 150 years (Fogel 1994). Additionally, the length and height of the cranial vault has increased, while vault breadth has decreased (Jantz and Meadows Jantz 2000). These findings suggest a potential secular increase in brain size. Miller and Corsellis (1977) reported a positive secular trend for brain weight. The skeletal elements encasing the brain provide an opportunity to indirectly examine secular change in brain volume. Although bone thickness influences cranial vault dimensions, craniometric data may be reliably used to examine cranial volume (Henneberg 1988). Cranial module [(cranial length x cranial height x cranial breadth)^{1/3}] measures the size of the cranial vault according to ectocranial dimensions. Our research investigated a potential increase in brain volume by examining the cranial modules of 749 American white males born between the 1830s and 1978. Crania were measured from the Robert J. Terry, Hamann-Todd, and William M. Bass Donated Collections, and from a collection of Civil War soldiers at the National Museum of Health and

Medicine. Secular change was assessed by regressing cranial module on decade of birth. Mean cranial module values significantly ($p < .05$) increased from 150.75cm in the 1830s to 157.23cm in the 1970s. To the extent that ectocranial dimensions accurately reflect brain volume, the results of our research suggest an increase in the brain volumes of American white males over the past 150 years.

In vitro validation of a finite element model of a chimpanzee cranium.

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Finite element modeling has become increasingly important in studies of functional morphology, but the question remains: do our models realistically represent biological systems? Valid results are dependent upon valid input parameters and modeling assumptions such as geometry, material properties and boundary conditions. By comparing the results of experimentally collected strain data, we can better characterize the errors that have resulted from our modeling assumptions. This study assesses the accuracy of our finite element modeling techniques by comparing *in vitro* strain data to strain data extracted from a finite element model.

In vitro strain data was collected during non-physiological loading from rosette strain gages affixed to the rostrum, palate and zygomatic arch of a female chimpanzee (*Pan troglodytes*) cranium. The prepared cranium was secured in a testing rig comprised of steel rods and spherical joints; loads were applied incrementally on the dentition to 800N using an Instron universal testing machine. Following the loading experiments, material properties were collected from sites across the cranium using ultrasonic techniques. The specimen was then imaged via medical X-ray computed tomography and a finite element model was built by segmenting trabecular and cortical bone and converting the resultant stereolithographic files to yield a solid 3D model. The model was edited, meshed, assigned heterogeneous, orthotropic material properties derived from the ultrasonic analysis and then loaded and constrained to simulate the experimental conditions of the *in vitro* study. Experimental and model results were compared with respect to strain magnitude, orientation and mode.

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Mammalian faunivores: prey, foraging, and microwear.

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Faunivorous and insectivorous mammals eat an extensive array of food items that vary substantially in their physical properties and offer different foraging challenges. Therefore, it is not surprising there are equally diverse adaptations for feeding on them including two morphological extremes. Small-bodied primate, bat, insectivoran, and marsupial insectivores tend to hunt and feed primarily on individual coleopterans, lepidopterans, and orthopterans. Morphologically they have elongate shearing crests and high dental complexity values relative to frugivores. On the other extreme are the myrmecophagous mammals from many mammalian orders that have evolved to prey upon on colonial insects (hymenopterans). These animals have convergently evolved reduced dentitions and dentaries.

Although extant great apes and humans consume insects and related prey, they do not demonstrate either of these typical faunivorous morphotypes. Given this, conventional analyses of dental morphology or jaw mechanics based on the comparative method will not work for dietary reconstruction of fossil hominins. An alternative is explored here. Dental microwear data suggest that small-bodied faunivorous mammals (include primates, insectivorans, and bats) tend to have greater feature densities than either frugivorous or folivorous primates. Dental microwear analyses on the only myrmecophagous mammals that have retained both teeth and enamel, the aardwolf and sloth bear, suggest that these foods are not masticated sufficiently to cause distinctive microwear features. These data on a diversity of modern mammals indicate that it may be possible to detect only certain forms of insectivory in early hominins based on dental microwear.

Correlates of early reproduction in the Dogon of Mali.

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Great progress has been made in applying life history theory to a wide range of problems in human biology, yet fundamental questions remain about the causes of intra- and inter-population variation in such life history parameters as age at menarche and first birth. To identify the predictors of early maturation and reproduction in the Dogon of Mali, I use data from a prospective cohort study of 1700 children, most of whom were enrolled in infancy and who are now ages 12 to 19 years. My focus will be on the 600 surviving girls in this data set and will include comparisons of girls who migrated to the city versus girls who remained in rural villages, as well as comparisons of the Dogon to other small scale societies. The median age at menarche in the Dogon data set is 16.89 (95% CI: 16.48 to 17.30) years and the median age at first birth is 19 years. I will discuss pathways through which energetic factors are inextricably tied to immune challenges, mortality schedules, and family structure variables, making it difficult to tease apart energetic and non-energetic influences on life history strategies.

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Social states, behavioral flexibility and social evolution.

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A constant theme in the study of social systems is how best to characterize sociality. Traditional paradigms use group size, numbers of adults of each sex, age distributions and kinship. Layered on these key "traits" is the persistence or stability of group membership and the nature of inter-group interactions. We use a dynamic 3-D model to describe dimensions of within-group cohesion over time and space, and apply this model to two contexts. The first examines groups at the extremes of their species' size ranges (e.g., squirrel monkeys, howler monkeys, colobus, mandrills), and the second examines known groups that have undergone marked changes in size and structure over time (e.g., lemurs, muriquis, baboons, macaques, langurs, mountain gorillas, chimpanzees). Using these and other examples, we identify constraints on social evolution due to female reproductive rates and kinship structures, and model outcomes in terms of social flexibility and adaptive potential.

Identification of dietary niche overlap in the primate fossil record using an extant competitive guild.

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Establishing the competitive environments surrounding the evolutionary origins of primate groups is contingent on accurately identifying dietary competition between fossil primates and their mammalian contemporaries. This requires the reconstruction of dietary niche overlap among extinct species using associations between dental morphology and dietary regimes in related extant taxa. These associations must hold across primates and their likely dietary competitors ("primate competitive guild") to directly compare species' niches. Competition is expected to occur within broad dietary categories (e.g., insectivory), but in studies of diet-dentition relationships across primate competitive guilds, more restricted dietary classifications have rarely been employed. This study's objective was to determine whether molar morphological variables are associated with specific dietary niches within an extant primate competitive guild.

Three-dimensional measurements of molar form were obtained from 73 species (Primates, Chiroptera, Marsupialia, Rodentia) from a single locality (Balta, Peru). Dietary categories were subdivided to create "operational dietary units" (ODUs), and species were assigned to ODU's based on a series of parameters, arranged hierarchically: primary dietary component, relative proportions of food resources, specific dietary items, and canopy foraging level. Principal components analysis was used to demonstrate separation of ODU's,

and canonical discriminant analysis was performed to identify the measures that maximized variation among ODU's. Results indicated that ODU's were differentiable within dietary categories by cusp sharpness, crest length, basin depth, and cusp height (first two principal components explained ~85% of the variation in the sample). These results provide an initial step towards refining reconstructions of dietary competition in the primate fossil record.

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The primary orientation of trabecular bone in the hominoid tibiotalar joint.

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The primary orientation of trabecular bone (Tb) has been demonstrated empirically *in vivo* to develop in alignment with the direction of applied habitual load. This study tested the hypothesis that Tb morphology and orientation in skeletal ankle bones differs among hominoids in ways consistent with presumed differences in the habitual loads across the joint during life. The shape and primary orientation of Tb underlying the joint surfaces was digitally quantified in 9 s ubregions from micro-CT images of the distal tibia and talus (astragalus) of *Homo*, *Pan*, *Gorilla*, *Pongo*, and *Papio*. In both the distal tibia and talus, humans were found to have relatively greater Tb anisotropy and displayed overall more elongated Tb than the non-human hominoids, consistent with stereotypically predictable, sagittal-plane locomotion. In contrast, orangutans had overall more isotropic, less elongated Tb in the talus than the other species, and there were no significant differences found in Tb shape among regions, both results consistent with habitual loads that are more evenly distributed throughout the bone. The primary orientation of Tb was significantly different between humans and the non-human hominoids in the posterolateral and anteromedial regions of the talus, although not in the distal tibia. This study furthers understanding of the functional morphology of trabecular bone and its potential in inferring locomotor mode in isolated skeletal specimens.

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3D biomechanical simulation of a fossilization process of a bony structure: new perspectives for the retrodeformation of paleo-anthropological fossils.

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One of the main difficulties in studying unearthed human fossils is that they have often undergone plastic deformation due to the slow movement of the surrounding geological layers, the increasing compression of the sediments that piled-up onto them, and more generally the diagenetic phenomena.

To investigate this issue, we designed a test-bed to simulate a fossilization process leading to a plastic deformation. We took a bony structure, plunged it into an acid liquid and applied a controlled mechanical load by using a calibrated weight. The bony structure then deformed plastically and 3D data are acquired regularly by using a surface laser-scanner or a volume CT scanner. This results in a time-series of 3D data representing the shape of the bony structure at different states of deformation.

3D image processing algorithms were applied to segment the external surface of the "fossil" in each 3D data of the time-series and to find automatically the point correspondences between the successive 3D surfaces. The resulting 3D displacement fields characterize the plastic deformation due to the "fossilization" process.

We used the SOFA software to build a mechanical model of the bony structure. This software proposes also several algorithms for describing various sets of constraints (pressure constraints, unilateral constraints, etc.) and it is particularly adapted for rapidly testing combinations of methods. By fitting the models of the structure and of the constraints to the observed 3D displacement field, we inferred some biomechanical laws which characterize a plastic fossilization process.

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Trabecular bone structure in the forelimb and hindlimb of quadrupedal primates and carnivores.

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Primate quadrupeds differ from most other mammals in having higher peak reaction forces on the hindlimb compared to the forelimb. Recent analyses indicate that primates in general have more robust trabecular architecture in the femur than in the humerus, independent of locomotor behavioral differences. These results support locomotor analyses indicating hindlimb dominance in primates, perhaps to allow the development of greater forelimb manipulatory abilities. Differential limb usage in non-primate quadrupedal species often reflects the opposite pattern of forelimb and hindlimb loading. The goal of this study is to explore the adaptive response of trabecular architecture in two contrasting loading environments, represented by primates and carnivores. High-resolution computed tomography scan data were collected

for the proximal femur and humerus of 20 individuals from three carnivore species, and 30 individuals from four primate species. Bone volume fraction, anisotropy, trabecular thickness, spacing and number were quantified in multiple volumes of interest within the articular region of each specimen. Despite significant differences in the kinematics of locomotion among the taxa analyzed, all species exhibit the same pattern of forelimb to hindlimb trabecular bone structural organization. Bone volume fraction is significantly higher in the femoral head than in the humeral head in all taxa, independent of locomotor behavior or taxonomic group. Humeral head trabecular bone is significantly more isotropic. These results suggest that individual measures of trabecular bone do not appear to reflect locomotor behavioral differences, and potentially indicate a canalization of femoral and humeral trabecular bone architecture across quadrupedal mammals.

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Bone microstructural features combined with synchrotron radiation x-ray fluorescence spatial maps of lead and strontium in historical bone samples from Antigua suggests biogenic uptake.

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A promising method to discern the diagenetic from biogenic origin of trace elements in archaeological bone is to identify the spatial distribution of the elements with synchrotron radiation x-ray fluorescence (SR-XRF) and match the spatial maps with histological features of the bone. We have successfully used this approach on cortical fragments associated with a nonsegregated Royal British Naval cemetery population (1793-1822) located in Antigua, West Indies. It has been suggested that during the early 19th century, members of the Royal British Navy were impacted by lead poisoning. We therefore hypothesized that evidence of biogenic lead uptake would be present in skeletons from this historical context but would be absent from precontact samples from the island. Secondly, we explored the distribution of strontium within these groups hypothesizing that the more mobile historical population would exhibit a more heterogeneous distribution of this element. This preliminary study (n=4 historical, n=1 precontact) revealed evidence of the biogenic uptake of lead in the historical Antigua samples, whereas the precontact sample was negative for lead. Both the historical and precontact samples exhibited heterogeneous distributions of strontium. This pattern suggests that pre-contact and post-contact diets consisted of food and water containing strontium and that these levels varied. While the use of SR-XRF is not novel, the successful application of this technique where trace element spatial distributions are mapped to discrete bone features holds new promise for the area of trace element research.

Comparison between Von Luschan tiles and spectrophotometry in human skin color variation.

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Prior to the introduction of skin reflectometry in the 1950's, human skin color was classified by a matching method using Von Luschan tiles. Unexposed skin was compared against 36 standardized, opaque glass tiles arranged in a chromatic scale. Our goal was to establish quantitative correlations between tile-based color-matching and reflectometry methods in order to make historical data accessible. Skin pigmentation measurements were taken at three locations (forehead, upper inner arms, and backs of the hands) using the tiles and narrow- and broad-band spectrophotometers in volunteers of a range of skin pigmentation in State College, Pennsylvania and Atlanta, Georgia. Only 50% of the tiles were used by the observers because some were of shades deemed unrealistic and others were difficult to distinguish from one another. Regression analysis indicated a moderate correlation between the tiles and melanin index (M) measured by spectrophotometry ($R^2 = 0.66$, $p = 0.004$). Volunteers self-identified their racial designation and ethnicity. The M values for each affiliation had distinct ranges, but also showed significant overlap. These data provided a range of M values for the tiles utilized and, more specifically, for the most commonly used and less problematic tile colors, and can later be used to approximate the M in historical studies.

The results of this study make possible comparison of historical, tile-based data with those collected using reflectometry. This is particularly important for populations now extinct, extirpated, or increasingly admixed for which tile-based data on skin pigmentation are the only type available.

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GRF moment arms about the knee in A.L. 288-1.

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Although it is generally agreed that australopiths were bipeds, some researchers project bipedal modernity into the early hominin fossil record, while others argue that australopiths utilized a 'bent-hip, bent-knee' form of bipedalism. Here we model potential midstance positions using human and chimpanzee kinematics as boundary conditions and combine those with human and chimpanzee body segment parameters to calculate the ground reaction force (GRF) moment arms about the

knee for A.L.288-1 and an average modern human female.

Midstance lower limb joint angles and body segment parameters for chimpanzees and modern humans were derived from the literature. 248,216 potential midstance positions were created using combinations of joint angles (one degree increments between boundary conditions) and segment parameters then were used to calculate total center of mass. Midstance positions were eliminated if they did not meet two criteria: 1. Total center of mass located above the foot. 2. Angle of trunk within the range of human and chimpanzee (bipedal) walking. The moment arm of the GRF about the knee was then calculated.

We found that a small percentage (~6%) of all potential midstance positions met our retention conditions. Joint angles that produced viable midstance positions were tightly clustered within the total range of kinematic possibilities and these positions were similar for the modern human female and A.L. 288-1. The total range of GRF moment arms about the knee was absolutely larger for the human (28 cm) than for A.L. 288-1 (20 cm), but were a similar percentage of lower limb length in both.

Ancient and modern genetic diversity of Iñupiat populations from the Alaskan North Slope.

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Iñupiat populations of Canada and Greenland, characterized by 'Beringian-specific' mtDNA haplotypes A2a/A2b (95%) and D3 (5%), are homogenous for mtDNA sequence diversity compared to American Indian populations. Less is known about Iñupiat populations of North Alaska. With the encouragement of local Iñupiat communities, we analyzed North Alaskan mitochondrial haplotype frequencies to place them in the context of American arctic prehistory.

The mtDNA hypervariable region was sequenced in 178 adults residing in all communities spanning the Alaskan North Slope. We sequenced the same segment from ancient skeletal remains (calibrated radiocarbon age 1187-1579AD) from Nuvuk, an Iñupiat/Thule village at Point Barrow, AK continuously inhabited for ~1300 years. There is considerable variation in the frequencies of mtDNA haplogroups among the modern communities investigated, with haplotypes A2a/A2b (88%) and D3 (7%) the most common. Ancient Nuvuk individuals also reveal the expected A2a/A2b/D3 haplotypes, though with additional A2 sublineages not found in the modern samples. Haplotype D2 (3%), found among modern Aleut, Siberian Eskimos, and recently in an ancient Paleo-Eskimo Saqqaq from western Greenland,

was identified at a low frequency in the modern samples but not the ancient.

These results suggest that only a subset of Beringian-specific mtDNA haplotypes were carried by the early Thule during their dispersal across the North American arctic, and the Alaskan North Slope possibly served as a source for the earlier Paleo-Eskimo diaspora. The unique diversity of arctic mtDNA haplotypes encourages the future sequencing of full mtDNA genome, NRY, and autosomal markers in modern and ancient samples.

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Pelvic sexual dimorphism among species monomorphic in body size: commonalities and relationship to newborn size.

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This study evaluates pelvic sexual dimorphism as an obstetrical adaptation among eight species – three primates (*Aotus azarae*, *Hylobates lar*, and *Saguinus geoffroyi*) and five others (*Castor canadensis*, *Dasyus novemcinctus*, *Sciurus carolinensis*, *Sylvilagus floridanus*, and *Urocyon cinereoargenteus*). As nonpelvic sexual size dimorphism (SSD) influences pelvic SSD, all eight species are sexually monomorphic in body size. The study addresses two issues. First, do the species show commonality in pelvic SSD and fusion of pelvic joints? Second, do the species that give birth to relatively large newborns have a higher magnitude of pelvic SSD and lower prevalence of pelvic joint fusion than those giving birth to relatively small newborns? Based on published data for 372 species, the three primates are characterized as giving birth to relatively large newborns and the five others as giving birth to relatively small newborns. Nine measures of the pelvis were taken; fusion of interpubic and sacroiliac joints was observed. Results are the following. First, the species show no commonality in pelvic SSD or prevalence of pelvic joint fusion. Second, based on relative newborn size, the two groups of species do not differ in magnitude of pelvic SSD or prevalence of sacroiliac joint fusion. The primates do have a lower prevalence of interpubic joint fusion. The following interpretations are presented: (1) there are multiple pathways to achieve an obstetrically sufficient pelvis; (2) pelvic and nonpelvic sizes are not related in some species; and (3) an unfused interpubic joint is an important obstetrical adaptation.

Paralouatta, the Cuban enigma: evidence from postcranial morphology.

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Paralouatta varonai is a Miocene-sub-recent taxon from Cuba that is exceptionally well represented postcranially in the platyrrhine fossil record. The original description of this material posited an organism adapted for semi-terrestrial locomotion; this is notable as there are no primates within the extant platyrrhine radiation that practice terrestriality as a significant component of their locomotor repertoire. However, the original description also left open the possibility that some of these potentially terrestrial traits in *Paralouatta* (which are similar to those present in Old World monkeys) are actually plesiomorphies shared with a common anthropoid ancestor.

In order to clarify both the potential locomotor pattern of *Paralouatta* and the degree to which it is derived, each fossil element was compared to a broad sample of extant platyrrhines and cercopithecoids, as well as Miocene and Oligocene fossil primates from Africa and South America. Three-dimensional landmark data were collected using a Microscribe 3DX digitizer or using Landmark Editor and the data were subjected to standard multivariate statistical analyses.

Results indicate that while there may be a few characteristics derived towards semi-terrestrial locomotion, particularly in the phalanges and the olecranon process of the ulna, the strongest locomotor signal points towards an arboreal quadruped that would have included leaping as an important component of its repertoire, most similar to modern *Chiropotes* or *Aotus*. In addition, *Paralouatta* possessed a thumb that is longer than all modern atelids. Overall, the evidence suggests that *Paralouatta* had a less derived postcranial skeleton in comparison to extant atelids.

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Comparisons of strength and predictability of Neanderthal and modern human femora using finite element analysis.

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Traditionally, analyses of femoral morphology have examined the effect of skeletal variables on structural integrity separately, an approach that does not incorporate information on the whole bone. Finite element analysis allows exploration of the structural integrity of complete Neanderthal and recent modern human (RMH) femora in order to obtain a detailed picture of precisely how the characteristic differences between these femora affect their strength and strain predictability, while taking into account loading patterns produced by differences in the configuration of hip and knee joints. Finite element models of femora of a

Neanderthal and RMH were used to investigate how differences in antero-posterior curvature, neck-shaft angle, diaphyseal cortical bone thickness, and transverse cross-sectional shape affect strength and predictability of strain distribution during three scenarios typically encountered during locomotion: 1) the moment of peak body weight transmission during regular bipedal walking, 2) irregular steps, and 3) traumatic force impact.

Six experiments were conducted, three assessing strength and predictability incorporating size *and* shape information, and three using isometrically scaled forces such that only shape differences are evaluated: the first two experiments mimicked normal bipedal walking, simulated at the moment of peak acetabular contact force (314.8% body weight) during the stance phase of gait. The second two explore the consequences of an irregular step, such as a stumble and were simulated as double the value of peak acetabular contact force oriented at an altered angle. Lastly a traumatic load was simulated by the application of a horizontal force (500 N) directed toward midshaft.

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Scaling of jaw-muscle fiber architecture in platyrrhines: a preliminary assessment.

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Recent comparative investigations of jaw-muscle fiber architecture in callitrichids and cebids have provided important insights into how jaw-muscle architecture relates to masticatory apparatus form and feeding mechanics in platyrrhines. Here we extend these analyses to assess the relationships among jaw-muscle fiber architecture, jaw size, and jaw robusticity across platyrrhines. We computed the normalized fiber lengths and physiologic-cross sectional areas (PCSAs) of the superficial masseter and temporalis muscles in 11 platyrrhine species. Our initial reduced-major axis regression of a combined estimate of masseter and temporalis PCSA suggests positive allometry relative to jaw length (slope = 2.3; $p < 0.01$), but does not rule out isometry. Alternatively, masseter and temporalis fiber lengths may scale with negative allometry (slope = 0.9 and 0.7, respectively; $p < 0.03$). In addition to a potential size-related increase in muscle force-producing capacity, hard-object feeders such as *Cebus apella* exhibit relatively large PCSAs. By contrast, the more folivorous *Alouatta seniculus* displays a relatively reduced jaw-muscle PCSA, suggesting that large body size, rather than relative increases in jaw-muscle force production, plays an important functional role in howler feeding behaviors. Relative PCSA is significantly correlated ($r = 0.7$, $p = 0.02$) with a relative jaw robusticity index that tracks variation in the bony masticatory apparatus. Thus, hard-object feeders

tend to have both relatively robust mandibles and relatively large PCSAs, while more folivorous taxa such as howlers exhibit both relatively reduced jaw robusticity and jaw-muscle PCSA. Based on these preliminary findings, muscular and skeletal morphologies of the masticatory apparatus are co-evolving in platyrrhines and both play integral roles in feeding performance.

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The role of glia in human brain evolution.

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Human brain evolution presents a striking paradox. Modern humans have especially large brains with unusually high metabolic activity per gram of tissue. High levels of oxidative metabolism imply high levels of reactive oxygen species production, resulting in increased tissue damage. Despite this, humans live longer than any other primate and many humans maintain functional cognitive acuity for 80 years or more. Comparative genomic studies suggest that humans evolved patterns of gene expression to support high levels of synaptic activity and plasticity (Preuss et al. 2004). These studies also demonstrate an evolutionary up-regulation in the expression of genes involved in oligodendrocyte function and myelin formation in the human lineage relative to the ape lineage. The molecular consequences of genetic changes in the white matter of the brain may be directly relevant to the uniquely human features of cognition, longevity and neurodegeneration. We conducted histological studies of myelin-related proteins and activated glial cells in white matter in monkeys, apes, and humans. Our results indicate increased expression of some myelin-related proteins in human brains relative to ape and macaque brains, as well as species differences in patterns of microglia and astrocyte activation. Factors such as age and sex also play a role. These findings suggest that the balance of regenerative and destructive forces in the brain shifted in human evolution either by enhancing myelin regeneration by oligodendrocytes and/or by diminishing degenerative processes mediated by astrocytes and microglia.

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The evolution of allomaternal care in lemuriiforms.

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Allomaternal care (AC) of infants is hypothesized to benefit mothers and offspring by increasing infant survival and reproductive output. For primates, comparative analyses testing these hypotheses have mostly focused on anthropoids because studies of prosimian AC are rare. This research has shown that AC is associated with increased postnatal growth rates and decreased interbirth intervals (IBI). Recently, detailed studies of Malagasy primates have provided an opportunity to examine this question in non-anthropoid primates. We used these data to test the hypothesis that, like anthropoids, lemuriiform mothers benefit from AC. We used comparative analyses controlling for the influences of body size, phylogeny, and diet, and collected data from the published literature and Duke Lemur Center on 23 taxa for three dependent variables: IBI, prenatal growth rate, postnatal growth rate. We conducted phylogenetic generalized linear models to test the relationship between the dependent variables and five predictor variables related to different aspects of infant care: nest, park, AC, allomaternal nurse, and carry by caregiver. Nesting and parking were significantly and positively related to prenatal and postnatal growth rates, and the presence of nesting was negatively related to IBI. No significant relationship was found between the remaining predictor variables and our dependent variables. In particular, the presence of AC does not translate into more rapid infant growth, nor higher reproductive output, in lemuriiforms. Parking and/or nesting infants, which may indicate babysitting, benefited mothers and infants. The ever-increasing availability of detailed data is sure to provide insights into the evolution of AC in lemuriiforms.

Developmental changes in the spatial organization of neurons in the neocortex of humans and chimpanzees.

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We examined the development of the spatial organization of neurons in four regions of cortex (frontal pole [BA10], primary motor [M1], primary somatosensory [S1], and prestriate visual cortex [V2]) in fourteen chimpanzees and sixteen humans of both sexes. Horizontal spacing distance (HSD) and gray level ratio (GLR) of neurons in layer III were measured in Nissl-stained specimens that ranged in age from birth to 11 years of age. In chimpanzees, HSD increases during the first few years of life in BA10, M1, and S1, while spacing distance in V2 does not. In humans, HSD in the frontal pole increases during the protracted

development of the human frontal lobe, while there were no age-related changes in the other three regions. The HSD of neurons has been linked to modular and vertical characteristics of the cortex. Differences in the width of spacing between cortical areas reflect differences in anatomical organization. Our previous study of adults suggested that the human brain is characterized by an increase in the space available for interconnectivity with neurons in the prefrontal cortex compared to apes. This may be a consequence of the prolonged developmental trajectory of the human frontal lobe.

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A comparative analysis of serrated and non-serrated knife trauma.

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The interpretation of sharp-force trauma to bone is an important component of bioarchaeological and forensic anthropological investigations involving signatures of interpersonal violence, and the analysis of cut-marks on faunal remains can provide information regarding cultural butchering and subsistence practices.

Using 5-inch serrated and non-serrated steak knives, this macroscopic and microscopic study examined sharp-force trauma inflicted on pig ribs (n=100) in order to determine whether enough tool characteristics remained to distinguish between the two knives. Specifically, this study examined variables that included the length and width of the cut-mark, kerf morphology, and the presence of striations in bone.

Results of this study show that width of the cut-mark, presence of striations, and kerf morphology are the most accurate indicators of knife class. An ANOVA, T-test, and descriptive statistics were run showing that the average width of cut-marks from serrated blades was statistically significant at .910 mm, with all cuts falling above .60 mm, versus the .306 mm average from non-serrated blades, with most cuts falling below .50 mm. Striations occurred in 75% of all cuts made with the serrated blade, and 0% in non-serrated cuts. Finally, Y-shaped kerfs occurred in 82% of serrated cuts, while thin V-shaped kerfs occurred in 87% of non-serrated cuts.

These findings demonstrate the potential for discriminating between sharp-force defects (serrated versus non-serrated) present on bone. Distinguishing which characteristics are common to different blade classes will assist in clarification of sharp-force violence in forensic contexts, as well as provide information with reference to butchering and food preparation patterns.

Dental macro- and micromorphology of a new pitheciid primate from the Miocene of Patagonia.

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We report a new primate genus from Cerro de los Monos, of the early Miocene Pinturas Formation in central-western Patagonia, Argentina. Pinturas primates deserve attention because they are the most diverse assemblage known from Patagonia. Prior to this report, four species from Pinturas have been named: *Soriacebus ameghinorum*, *S. adrianae*, *Carlocebus carmenensis*, and *C. intermedius*.

The most complete specimen of the new primate is a palate containing the left I², P⁴-M¹, M³, roots of the left M², and of the right P⁴-M³. More than a dozen referred dental specimens exist. Molars and premolars are bunodont, with low occlusal relief. Upper molars are transversely broad and rectangular with large, rounded hypocones. Lower molars are buccolingually broad, with trigonids that are broad and taller than the talonids. The cristid obliquid is relatively short in the lower molars. Cusps, crests and crown sidewalls are smooth and rounded, with shallow basins. The mandible is robust at the symphysis, and near the alveolar surface. SEM analysis of enamel microstructure reveals a radial pattern as in *Callicebus*, contrasting the highly decussating enamel of pitheciines. It suggests that molars in the new taxon were not used to process mechanically demanding foodstuffs.

This morphology is also similar to *Carlocebus* and *Homunculus*, supporting a link to Homunculinae (including *Callicebus*). However, the new taxon is somewhat larger and more bunodont. Since there are at least three Miocene homunculine genera in Santa Cruz, this reinforces the idea of an unexpectedly high diversity of the pitheciid radiation in extra-Amazonian, Neogene South America.

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Reconstruction of systemic stress using incremental microstructures of enamel in an individual from the Late/Final Jomon period, Japan.

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This study reconstructs systemic stress patterning using incremental microstructures of enamel in a subadult from the Yoshigo cemetery (3200 through 2800 BP), Aichi Prefecture, Japan. High resolution impressions and replicas were collected for each anterior tooth. Each

replica was studied under 50, 100, or 200x magnification on a measuring microscope. Distances between perikymata grooves and from the lens to the objective were recorded using specialized software. LEH defects were identified as accentuated spacing in perikymata combined with a depression in the enamel surface and were chronologically matched across the dentition. Each defect was placed within a chronological sequence based on decile location and distance from the cemento-enamel junction. Stress duration was estimated by counting the perikymata in the occlusal wall of each defect and multiplying that value by the modal periodicity for striae formation. Percentage of enamel growth disruption was estimated by dividing the number of perikymata within the occlusal wall of each matched defect by the total number of perikymata within the imbricational enamel. Eight LEH defects were chronologically matched. Chronology of matched LEH defects ranged between 1.2 through 3.5 and 0.1 through 3.7 years of age when using the decile and height methods respectively. Number of perikymata located within the occlusal wall of each defect ranged from one through 20. Estimated durations of stress ranged from eight through 120 days. Disrupted enamel growth ranged from 8.1% in the maxillary left canine to 50.7% in the maxillary right central incisor.

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Ontogenetic variation in the ascending ramus of great apes and humans.

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Considerable variation exists in mandibular ascending ramus form among primates, particularly great apes. Recent analyses of adult ramus morphology by Rak and colleagues have suggested that ascending ramus form, especially the coronoid process and sigmoid notch, can be treated as a phylogenetic character that can be used to reconstruct relationships among great ape and fossil hominin taxa. However, it is currently unknown how ontogeny of the ramus contributes to adult variation. Specifically, it is unclear whether differences among adults appear early and are maintained throughout ontogeny, or if these differences appear, or are enhanced, during development.

To address these questions, the present study examined a broad ontogenetic sample of great apes and humans (*Gorilla*, *Pan*, *Pongo*, and *Homo sapiens*) using two-dimensional sliding semi-landmark analysis. Variation among and within species was summarized using principal component analysis, and Procrustes distances and discriminant function analyses were used to compare species and age classes. Results suggest that morphological differences among species in ramus morphology appear early in ontogeny and persist into adulthood. Morphological

differences among adults are particularly pronounced in the height and angulation of the coronoid process, the depth and anteroposterior length of the sigmoid notch, and the inclination of the ramus. In all taxa, the ascending ramus of the youngest specimens is more posteriorly inclined in relation to the occlusal plane, shifting to become more upright in the adult. The implications of these results for analyses of hominin phylogeny and the taxonomic assignment of hominin sub-adult mandibular remains are discussed.

Regional patterns of health in early medieval Ireland: distributions of non specific stress indicators.

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This study of regional patterns of ill-health in early medieval Ireland integrates data from a large data-set of archaeologically-retrieved human skeletal remains with their appropriate cultural and historical contexts.

Assessing a population's or region's overall health has been possible through the study of dental and skeletal stress indicators produced by the body's adaptive response to stresses such as malnutrition and disease. While physiological disruptions caused by stress cannot be directly measured in skeletal remains, their effect can be studied to provide a general health pattern of a population or region. These effects have been divided into three categories by Goodman and colleagues (1984): cumulative stress; episodic stress; and stress associated with specific diseases.

To date, over 1,200 individuals including both subadults and adults, from over 10 different early medieval cemeteries have been analysed for occurrence rates of non-specific stress indicators, including but not limited to; cribra orbitalia, porotic hyperostosis, dental enamel hypoplasia, and tibial periostitis, all of which have been observed and associated with disease and malnutrition in modern populations.

Statistical examination of the findings have shown there to be significant regional differences, with northern populations appearing to have higher frequencies of ill-health than their southern counterparts. Concurrently, differences between the stress indicators in question have appeared, suggesting cultural and environmental factors impact each stress indicator differently. These indicators have provided an insight into regional patterns in health in early historic Ireland.

Estimation of biological sex from activity patterns for subadult skeletal remains from the Windover and Indian Knoll Archaic populations.

GEOFFREY P. THOMAS. Anthropology, Florida State University.

Prior to maturation and the full development of sexually dimorphic characters, it is extremely difficult to estimate the sex of subadults in archaeological samples. The objective of this study is to identify gender or

sex specific activity patterns as reflected in the osteometric and cross-sectional asymmetry of adult upper limbs, and to test the predictability of sexing subadults based on these observed patterns in the Windover and Indian Knoll Archaic populations. Differences in subsistence strategy and culturally specific behaviors relating to the division of labor need to be taken into account when reconstructing prehistoric activity patterns in both adults and subadults. Assuming that subadults gradually begin performing adult tasks, and that their activities are determined primarily by age and sex, at a certain age subadults should begin to diverge and cluster with either the males or females of the population. Ethnographic data for foraging groups indicate that the youngest age groups (under 6 years) are typically performing female activities. After this age boys begin performing male tasks. As they enter adolescence there should therefore be clear morphological distinctions in the subadult remains corresponding to the asymmetry patterns seen in the adults. The results of this study show that discriminant tests using the most sexually divergent measurements of asymmetry (principle components) from the adult and subadult samples are successful in reclassifying 71.4% (Indian Knoll) and 100% (Windover) of the subadults into the adult sex categories.

Investigation of dental metric and morphological patterns associated with expression of the Uto-Aztecan premolar.

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The Uto-Aztecan premolar (UAP) is a rare dental variant observed primarily on the first maxillary premolar. In skeletal samples of moderate size, population frequency of the trait is typically low (<5%). Although the UAP was originally believed to originate around 4,000 BP and have a presence restricted to New World populations, recent reinvestigation has revealed a much wider temporal and geographic distribution. Despite these new developments, there are still a number of heavily studied prehistoric skeletal populations in which no data on the UAP exists. Furthermore, it is unknown whether individuals that do express the trait are phenotypically distinct in any other aspects of the dentition.

This study presents new information regarding the presence of the UAP in several skeletal samples from the lower Illinois Valley and American Bottom regions. Similar to previous findings, frequency of the trait was low, ranging from 0-3%. Instances of both bilateral and asymmetrical expression were observed. In addition, all other morphological variants described in the ASU Dental Anthropology System and buccolingual and mesiodistal dimensions of the crown were recorded for every individual in each skeletal sample. This allowed for investigation into whether inter-trait correlations or metric trends exist in relation to those that express the UAP.

This study was funded by the David C. Skomp Fellowship Fund of the Department of Anthropology, Indiana University.

Can male white-faced saki monkeys (*Pithecia pithecia*) detect female reproductive state?

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Copulating during ovulation is critical to both male and female reproductive success. However, male knowledge of ovulation may not always be advantageous for females, as it could hinder mate choice or promote harassment. White-faced sakis show no obvious physical or behavioral signs of ovulation, although males often sniff female genitalia prior to copulation. We collected data on free-ranging white-faced sakis at Brownsberg Naturepark, Suriname in order to assess whether male copulatory decisions reflect knowledge of ovulatory timing. We recorded all occurrences of copulations and genital inspections for five females over a 17-month period. Fecal samples were also collected and radioimmunoassayed for estradiol and progesterone in order to determine female reproductive status. We found that males copulated throughout the female reproductive cycle, although the association between copulations and reproductive state varied between dyads. Only one male-female dyad copulated significantly more than expected during ovulation, although 80% of dyads copulated less frequently than expected with pregnant females. Genital inspections were distributed randomly with regard to reproductive state. However, males were more likely to mate with cycling females than with non-cycling females after genitally inspection. Regardless, males were no more likely to copulate with females while ovulating than during other times of the cycle. Our data suggest that while white-faced saki males gain some olfactory information on female hormonal status, they do not make entirely accurate decisions with regard to copulation timing. Male sexual experience and pair-bond familiarity may also play a role in the ability to detect female reproductive status.

This study was funded by NSF (BSC-0925122) and The International Primatological Society's Research Grant.

I am hot! No, you're not: an investigation of the complex relationship between self-perception of mate value and the assignment of mate value by others.

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Sexual selection, particularly in humans, involves a highly complex array of factors. The perception of physical attractiveness is one such area. Previous research has focused on such issues as hormones as contributors to perceived mate value (Miller et al. 2007), as well as duration of mating as a determinant for assessing physical attractiveness (Confer et al. 2010). One particular area of interest that has only recently been given much attention is that of self-perceived mate value. Specifically, such research

investigates how self-perceived mate value affects the perception of mate value in others (Bailey et al. 2011).

Our research investigates whether male and female self-perceived mate value provides an accurate assessment of the average actual mate value assigned by others, both same-sex and of the opposite sex among 250 young adult volunteers of three ethnic groups. Self-perceived mate value was determined by employing a Self-Perceived Mating Success scale. Actual mate value was determined by administering the same scale to those evaluating participants after evaluating themselves. Photographs of males and females were the media for evaluation by participants. The results not only demonstrate the disparities and similarities between self-perceived value and those values assigned by others, but also illustrate the use of value perception as a measure of evaluation for potential mates, as well as potential competitors. Such findings reveal that perceptions of physical attractiveness are themselves complex phenomena that encompass a constellation of factors both explicit and tacit that comprise yet another level of the complex process behind human sexual selection.

Passive joint motion of the chimpanzee knee, ankle, and foot.

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Changes in lower limb joint morphology have played major roles in the evolution of hominin locomotion. Reduction in ankle range of motion and stabilization of the tarsal joints were necessary to transform the lower limb into an efficient lever for bipedalism. Ranges of joint motion in hominids are usually inferred from osteological landmarks on skeletal elements; however, such osteological correlates of joint motion need to be verified via *in vivo* studies of joint motion.

2D cineradiographs of the knee, ankle, and foot were taken during passive flexion/extension bouts in three chimpanzees (*Pan troglodytes*, ages 4-5). Osteological markers were digitally tracked in order to determine ranges of motion and instantaneous joint centers (IJC).

Range of knee motion was near or within that of modern humans. However, extreme flexion in chimpanzees was accomplished by a posterior 'rolling' of the femoral condyles on the tibia, as evidenced by a posterior movement of the IJC. Ankle range of motion was double that seen in a human sample, and greater than the range predicted by some osteological metrics. In particular, maximum plantarflexion did not appear to be limited by the talar tubercles. Midtarsal motion exhibited greater complexity than previous studies have suggested. In light of these results, osteological features used to infer joint mobility in the hominid knee, ankle and foot may need to be reevaluated. These results will benefit musculoskeletal modeling studies of chimpanzees and extinct hominins by allowing

more accurate reconstructions of ranges of motion and estimation of muscle moment arms.

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The potential of entheses for estimating age.

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Entheses, sites where muscles attach to bone, have long been used in bioarchaeology to reconstruct past activity. Since these markers also correlate with age, it has been suggested that enthesial robusticity may be useful for age estimation. In an effort to test this idea, the robusticity of 9 femoral entheses and 7 humeral entheses were scored on 495 individuals from the Hamann-Todd collection. Scores were given as follows for fibrous entheses: 0 for no enthesial development, 1 for either a defined or elevated enthesis, 2 for both a defined and elevated enthesis, 3 for a defined enthesis with porosity, and a 4 for an enthesis that was both porous and had lost definition due to bone resorption. Spearman rank-order correlations were performed between each enthesis and age. Though nearly all entheses demonstrated a significant correlation with age, only two had a correlation value greater than 0.5 (a moderate correlation): the proximal and the middle linea aspera. Combining these two scores into a composite score increased the correlation coefficient from 0.534 and 0.536, respectively, to 0.565. This composite score results in 9 stages whose age ranges were calculated out to two standard deviations on either side of the mean age for each score. The average range is 50 years total or 25 years on either side of the average age for that score. The size of these ranges is not ideal for age estimation but this method may be utilized when the traditional skeletal elements used for aging are not available.

Survival and abandonment of indigenous head shaping practices in the Colonial Andes and Mesoamerica.

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Cranial modification was a widely spread and deeply rooted practice in many parts of the pre-Columbian world, specifically in Mesoamerica and the Andes. The Hispanic conquerors soon suppressed this indigenous custom as part of their colonization strategy of forced assimilation of all non-European sectors. Subsequently, native head modeling was either abandoned altogether or was gradually replaced by alternative head practices. However, within the broader sphere of Hispanic America, specifically the Andes and Mesoamerica, this process did not progress uniformly but operated under divergent circumstances and in different time frames. Here we examine the cultural dynamics operating in the abandonment or replacement of native head practices in Hispanic America. Our study is founded on systematically collected (ethno)historical accounts on the Andes and Mesoamerica and published cranial data of

16 skeletal series from the regions' colonial period. We conclude that the key to evaluating the colonizer's reaction to artificial head modifications resides in their visual results, being much more obvious than other, less visible, native traditions and therefore more easily subjected to pressure from the new dominant social sectors. This is especially true in the Andean cultural sphere with its strong and diverse vault modifications, which openly signaled the ethnic identity and social distinction of their human carriers. In Mesoamerica, where only tabular erect head shapes persisted at the time of contact, it was the Spaniards' suppression of cradle board use itself that subdued head modification practices, first in the European urban centers and finally also in the native rural hinterlands.

Tabula incondita: mixed phylogeographic signals found within a megabase of chromosome 9.

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It is well known that geographic distributions of many alleles are clinal. These phylogeographic patterns likely represent the spread of variability under a model of a wave of diffusion or document successive founder events into virgin territory. Genetic hitch-hiking predicts that linked variability gives concordant patterns contingent on the impact of recombination events and the influence of signals propagated by nearby genes. Here, a phylogeographic analysis of one megabase from chromosome 9 reveals multiple interspersed and conflicting signals.

This study uses Stanford CEPH-HGDP SNP data of 675 unrelated individuals from 36 Eurasian populations to explore whether estimates of anisotropy are concordant within one megabase from chromosome 9 (q33.3-34.11; 129,500,000 - 130,500,000). The set of genotype data for this region includes 169 SNPs that are on average 5,924 bases apart. This stretch of DNA has a moderately high recombination rate, multiple LD blocks when analyzed for major regional populations, and many genes. Analysis of anisotropy using angular correlation reveals significant correlations for 122 SNPs; 61 SNPs indicate a general East-West cline and 61 SNPs a general North-South cline. The signals of anisotropy of the different SNPs, however, are effectively interleaved often with adjacent SNPs giving opposite and significant signals. This is in contrast to previous work done on a single large gene on chromosome 1 that showed concordant signals in adjacent SNPs within the same linkage blocks. In the present case, gene density, the influence of selection, and recombinational history appear to have well-mixed the region.

Secular change in stature among Nigerian populations.

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This research examines secular change based on cadaver stature among Nigerian populations born during the 20th century. It was hypothesized that significant differences in stature would be observed due to historical events that limited resource access and perpetuated persecution of ethnic groups. Cadaver stature was collected from 223 Nigerian individuals (151 males and 72 females) at the Lagos State University Medical School in Nigeria. The years of birth ranged from 1928 to 1994, and all identified individuals were known to lack metabolic or nutritional deficiencies. Regression of cadaver stature on year of birth allowed for the assessment of secular change. Nonparametric tests were used to compare males and females, as well as two ethnic groups in Nigeria (Igbo and Yoruba), each with a distinct culture and language. Initial results suggest that there was no pattern of secular change in cadaver stature. Interpretation of the results allowed for a discussion of the effects of historical events in Nigeria. Individuals born prior to 1960 represent birth during the colonial period. Those born between 1960 and 1979 were born during post-independence and the civil war period, and the individuals born between 1980 and 1994 represent a period of foreign aid and integration into the global market. These results were also compared to secular change in long bone length of Black individuals in the Terry Collection. The conclusions suggest that the historic events in Nigeria may not have influenced stature or that socio-political conditions remain that do not allow secular change to take place.

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Bipod lengths during quadrupedal walking in the kinkajou (*Potos flavus*): another step toward understanding the evolution of diagonal-sequence gaits.

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Diagonal-sequence, diagonal couplets (DSDC) walking gaits provide two simultaneous advantages for primates and other mammals with grasping hindfeet: forelimb testing of a new support with a secured hindlimb grasp near the center of mass, while minimizing periods of bipedal support on two ipsilateral limbs. However, kinkajous rely predominantly on DSDC gaits despite lacking grasping hindfeet. Lemelin and Cartmill (2010) reconciled this paradox by proposing that walking gaits with higher diagonality maximize the linear distance between two contralateral feet (or diagonal bipods) during the much longer periods of diagonal bipedality of the gait cycle, thus potentially increasing stability for locomotion on relatively thin supports. We compared lengths of diagonal and ipsilateral bipods and other kinematic variables of two kinkajous walking

quadrupedally on two poles of different diameter and a runway. Digital videorecordings of over 400 gait cycles were imported to a motion-analysis software for calculation of speed, bipod lengths, and limb joint angles. As speed did not differ across substrates, length of diagonal bipods was significantly longer on poles compared to the runway ($P < 0.05$). However, length also increased for ipsilateral bipods on poles. This is shown to be a necessary corollary of the phase shift between fore and hind limb cycles that increases diagonality. On thin arboreal supports where all footfalls are essentially collinear, DSDC gaits may be advantageous in increasing the length of the support base—if duty factors are low and bipods correspondingly predominate in the cycle of support patterns.

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Mortality and stature in European antiquity.

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Although stature is primarily influenced by heredity, external factors such as maternal health during pregnancy, early nutritional intake, illness/disease, and physical labor exert influences on the growing body, overriding genetic potential. Several studies of stature in ancient populations have also shown a relationship between short stature and early death. This study of 2023 skeletons, ranging from 7000 BP to the early 1900s and broadly distributed across Europe, seeks to address whether trends between stature and age at death can be determined. The sample was subdivided into three periods—Moderns (AD 1800-1950), Medievals (AD 500-1500) and Pre-Medieval (5000 BC-AD 350). Analysis of stature among period and by sex shows significant increases in height for males and females Medievals (ANOVA, $p < 0.001$), followed by decreases in Moderns (ANOVA, $p < 0.001$). When examined by age groups (20-39 and 40+), our data does not indicate that shorter individuals were more likely to die younger, with no difference between most age groups and younger Moderns and Pre-Medieval males actually exceeding older ones in height. We also found significant variability across regions, with some areas (England, Scandinavia and Germany) showing age-related decreases in height and the opposite in others (France and Spain). We conclude that, while being short may indeed increase the likelihood of dying younger, this relationship would likely hold true only under specific life conditions. Under normal circumstances, the complexity of factors that determine stature would likely mask broad trends. We suggest that the “short die young” hypothesis should be tested in regionally limited samples.

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Dental fluorosis in ancient Cuma, Italy.

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Recent excavation in Cuma (South Italy) revealed the existence of a large roman necropolis dated from 200BC to AD 200. Paleopathological analyses evidenced a rate of caries inferior to 3% for all teeth present which is very low for roman population (8-12% on average) and for modern populations. In addition, the rate of linear enamel hypoplasia (>65% of individuals) is very high. Finally, one of the individuals exhibits significantly whiter teeth, which can be attributed, among other things, to dental fluorosis.

Even though several causes can generate such an association, studies in neighboring contemporary cemeteries, notably in Herculaneum, have identified similar patterns securely diagnosed as dental fluorosis through direct SEM analyses.

Since, fluorine is naturally present in local underground water sources and contributes even today to low caries rates in Italian populations, we decided to test this hypothesis. We sampled 3 identified archaic water wells, 2 on-site and one just outside the necropolis, for fluorine content. Fluor levels ranged from 3mg/L to over 10mg/L which is 3 to 10 times higher than observed levels outside the site (≈ 1 mg/L).

Altogether, this evidence suggests the presence of endemic dental fluorosis and expands the known geographic occurrence of such patterns in Southern Italy.

Small mammal assemblages from the Chadron Formation of Nebraska and implications for understanding late Eocene primate community ecology.

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The end of the Eocene in North America is characterized by climatic change, faunal turnover, and an associated decline in primate diversity. While primates survive in tropical refugia during the late Eocene, they eventually go extinct in the Oligocene of North America. Gaps in the distribution of fossiliferous late Eocene deposits and knowledge of small mammal communities limit our understanding of this critical period in North American primate evolution. As a result, we have undertaken paleoanthropological fieldwork in late Eocene Duchesnean- and Chadronian-aged deposits within the Oglala National Grassland of northwestern Nebraska in order to address small mammal diversity during this important period.

In this paper, we present preliminary analyses of small mammal fossils from a concentration of anthill accumulations in the late Eocene, Peanut Peak Member of the Chadron Formation in northwestern Nebraska. The relative concentrations of small mammal taxa were calculated on the basis of mandibular and maxillary premolar and molar taxonomic identifications. To date, our faunal concentrations are: Multituberculata (0.5%), Marsupialia (4.0%), Insectivora (11.1%), Primates (0.25%), Lagomorpha (6.8%), Rodentia (66.5%), and Carnivora (10.8%). These percentages are similar to previously reported data from the nearby Chadronian-aged Raben Ranch locality, despite disparate taphonomic agents accumulating the fossils. These data expand our knowledge of an important period in North American primate evolution, during which there is a change in the taxonomic composition of small mammal communities accompanied by a decline in primate diversity.

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Face me like a man (or, like a woman): antemortem nasal fractures in pre-Columbian San Pedro de Atacama, Chile.

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The Middle Period (AD 400-1000), in San Pedro de Atacama, Chile, was a time of prosperity and foreign influence, however, also of conflict and violence. Analyses of antemortem nasal fractures in 443 individuals interred in five contemporary cemeteries allows for an exploration of interpersonal conflict in a time of a peace.

Our analysis showed 70 (15.8%) adults had antemortem cranial fractures; the overwhelming majority was limited to fractures of the nasal bones (58/72 injuries; 80.6%). Very few fractures (5/72 injuries, 6.9%) were on the vault. This pattern suggests face-to-face confrontations, where those involved were in close contact. Although fractures were more common among males, this was not significant, suggesting both sexes were involved in physical confrontations. There are some significant differences between the sites in the presence of nasal fractures suggesting the possibility that these patterns were affected by social status. Closer examination of two socially distinct cemeteries from the Solcor *ayllu* supports this, with 8.6% of individuals from Solcor 3 injured in contrast to 18.6% from Solcor Plaza, a difference that is significant for males ($\chi^2=7.022$, $p=.008$).

The predominance of injuries that likely resulted from face-to-face combat suggests that conflict was resolved in an intimate and standardized manner. The high rate, reaching 30% in one cemetery, indicates that a not inconsequential portion of the population was involved in violent activity. Placing our data in their archaeological context suggest that individuals likely both inflicted and suffered from these nonlethal injuries despite generalized peace and affluence.

This study was supported by a generous from grant from the NSF (BCS-0721229), the Fulbright Program, and Colorado College.

Defining local and regional strontium isotopic variability in the southeastern Maya periphery.

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Stable strontium isotopes are a useful tool to aid the identification of individuals in a human skeletal population who are of non-local birth. This technique is imperfect, and the possibility remains that behavioral factors may confound the interpretation of results.

The southern Belize region is typically considered geographically and culturally peripheral to the primary activity of Ancient Maya prehistory. Researchers have suggested that from the Early Classic on, southern Belize functioned as an important trade route between the Caribbean Sea and inland urban centers. *Orthogeomys hispidus* and *Pachycephalus* samples were collected from numerous locals throughout greater southern Belize region. Strontium isotopic ratios (⁸⁷Sr/⁸⁶Sr) obtained from these samples served as proxies to estimate the locally expected ranges of biologically available strontium for humans who inhabited sites throughout the region. ⁸⁷Sr/⁸⁶Sr values were obtained from the dental enamel of 30 adult and subadult individuals interred from the Preclassic to Late Classic Period southern Belize site of Uxbenká.

The results of this study indicate that the strontium isotopic data suggest that all individuals recovered from Uxbenká have strontium ratios which fall outside the range expected for the local area. Although the possibility does exist that no individual in this study did in fact live at Uxbenká during their childhood, other, more plausible explanations include access to foreign foods or condiments with higher ⁸⁷Sr/⁸⁶Sr ratios (e.g., marine resources, salt, lime) in the diet. These data stress the importance for multiple lines of evidence when undertaking strontium isotopic studies on ancient human populations.

Climate change and the behavioural ecology of *Propithecus coquereli* in northwest Madagascar.

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Shifts in temperature and rainfall can impact the behavioural ecology of primates. We tested the hypothesis that climate change has resulted in habitat alteration that would impact the behaviour and ecology of *Propithecus coquereli*, an endangered lemur species.

We conducted a 14-month study from 2007-8, documenting the behavioural ecological characteristics of four groups of *Propithecus coquereli* in Ampijoroa forest station, Ankarafantsika National Park, northwest Madagascar. We compared our results with a study conducted at this site in 1970/1. If there

have been any changes to the climate or habitat in Ampijoroa between 1970/1 and 2007-8, *Propithecus coquereli* may, in turn, alter their behavioural ecological strategies. We used tree height as a proxy for habitat alteration between the two studies.

We found that mean minimum temperature differed significantly between our 2007-8 study and the 1970/1 study and that rainfall and temperature showed significant variation between 1998 and 2008. We found no significant differences in tree heights between each study. Several of the behavioural ecological variables did not show differences, but we did find significant differences in seasonal feeding heights and home range size. However, these differences may be related to known within-site variation in habitat quality or group density.

This study has shown that the climate in Ampijoroa has shifted since the 1970's. Despite these shifts, the habitat does not appear to be greatly altered and much of the behaviour and ecology of *Propithecus coquereli* in Ampijoroa has remained static.

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Compensatory mechanisms of multiple debilitating traumas: a case study from the Oneida State Custodial Asylum in Rome, New York.

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While frequencies of traumatic lesions during the historic period in the United States were low (with an average of less than 10 percent of the population exhibiting one or more traumatic lesions), one individual, a 45-55 year old male from the late 19th century who is associated with the Oneida State Custodial Asylum in Rome, NY, exhibits 18 healed traumatic lesions. As some of his injuries were debilitating, the analysis of these lesions and the associated pathologies in the context of his residing in an institutional setting may lead to a greater understanding of the biological and social compensatory mechanisms involved in long term recovery processes.

The skeletal remains of this individual were analyzed using macroscopic visual methods. There are partially incapacitating fractures in his cervical vertebrae and debilitating fractures in the left elbow joint. The fracture to the second cervical vertebra disassociated the dens from the body of the vertebra, which would have hindered head and neck movement. The fracture to the left elbow was the result of blunt force trauma that disfigured the distal end of the humerus and proximal ends of the radius and ulna. The eburation with grooves in the elbow joint suggests that this individual developed a compensatory mechanism which allowed him to use this joint during and after the healing process. An examination of the potential mechanisms of these injuries as well as the biological and social compensatory mechanisms that allowed this individual to survive and

function in an institutional setting will be presented.

Dietary microfossils from Rapa Nui dental calculus: does regional variability provide evidence for subsistence practices?

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Microfossils extracted from dental calculus represent dietary and/or occupational artifacts embedded during life, offering a direct view of human-environment subsistence relationships. While recent studies have reported on the successful recovery of microfossils from calculus, this study is the first to employ high frequency sampling from a large archaeological human skeletal collection (n = 114/866 specimens, 13.2%). In addition to presence-absence data, our dental calculus sampling strategy provides additional evidence for subsistence activities and the geographic distribution of important foods. We recovered dental calculus from teeth of 114 Rapa Nui skeletons from 12 important regional sites dating from the late prehistoric and early protohistoric era (AD 1680 – 1750), employing SEM-EDS microanalysis to identify and quantify major taxa of embedded phytoliths and diatoms (n = 16,484). The majority of phytoliths were classified as globular echinate (n = 4,535), characteristic of Aracaceae (palm). Small numbers of grassy (Poaceae; n = 266) and unidentified phytoliths (n = 17) were also recovered. These results suggest a restricted diet throughout the island in the late prehistoric period and argue against the traditionalist notion that the people of Easter Island committed “ecocide” by cutting down the island’s palm trees, or that commensal introduced species such as the Polynesian rat (*Rattus exulans*) extirpated the palms prior to European contact. Our study demonstrates that geographically extensive, high frequency sampling for calculus-derived microfossils permits testing precise hypotheses about dietary adaptations and species persistence over relatively brief archaeological timescales, something not possible with small-scale calculus sampling.

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Substrate preferences relation to talo-crural shape: epigenetic and phylogenetic signals during ontogeny.

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Substrate preference has been demonstrated to influence adult talo-crural joint shape among catarrhine taxa independent of superfamily. The current study examines the ontogeny of substrate preference and superfamily effects on talo-crural joint shape.

Proximal talar articular surfaces from 116 catarrhine specimens, representing two closely

related hominoids (*H. sapiens*, *P. troglodytes*) and two cercopithecoids (*M. mulatta*, *M. fascicularis*) formed the study group, with dental eruption subsets (M1, M2, M3) examined for changes during ontogeny. The specimens were laser surface scanned, digitally reconstructed and landmarked. Generalized Procrustes analysis, Procrustes’ distances, regression analysis, and permutation tests were used to evaluate the significance and relative contributions of substrate preference and superfamily on talo-crural joint shape in each ontogenetic subset. The relationship of substrate preference and superfamily within in each subset was assessed using the angle between their respective vectors.

Permutation test results demonstrated shape was highly conserved with all but adult (M3) cercopithecoids S.D. (p=0.022, Bonferroni p< 0.008). Substrate preference became more important in determining joint shape from M1 to M3 (from 12% to 21% of variance), while superfamily became less (31% to 18%). Furthermore, these factors became more independent (62.2°) by M2.

Phylogenetic signal was observed at the M1 stage with progression to an epigenetic signal by M3 i.e., juvenile shape differences are governed more by phylogeny, but by adulthood, use may have a greater influence. Independence of substrate preference from superfamily is consistent with prior observations in larger samples of adult proximal talar and distal tibial facets.

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Multivariate calibration and body mass estimation in fossil hominins.

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Body size reconstructions of fossil hominins allow us to infer many things about their evolution and lifestyle including diet, metabolic requirements, locomotion, and brain/body size relationships. Due to the importance of these implications, accurate reconstructions of body mass have been attempted on numerous fragmentary fossil hominin specimens. Most calculations require a known “calibration” sample usually composed of modern humans, other extant apes, or a combination of both. Caution must be taken in these analyses as estimates are sensitive to overall size and allometric shape differences between the fossil hominin and the reference sample.

Statistically, the presence of size and shape differences forms testable hypotheses. In this research we test whether KNM-WT 15000 (Nariokotome Boy), a fairly complete *Homo erectus* skeleton, differs in size and shape from a large collection of modern humans. The modern human sample is comprised of recorded body mass and femoral measurements (head diameter, midshaft diameter) of 600 individuals from the

Hamann-Todd Osteological Collection and the Pretoria Bone Collection. Results indicate that WT-15000 does not significantly differ from this collection of humans in size (R_X= 0.0065, p=0.9357) or shape (R=5.5478, p=0.0624) on the basis of femoral measurements. Body mass is estimated as 54.2kg using a classical calibration method and 56.5kg (95% PI: 34.1kg – 92.3kg) using inverse calibration. Because WT-15000 does not differ in size or shape, inverse calibration should provide an unbiased estimate.

These results indicate that a modern human sample is an appropriate reference sample for estimating body mass for WT-15000.

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Environments of early Miocene Rusinga Island and Songhor: evidence from the dental microwear of tragulids.

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Miocene deposits on Rusinga Island and at Songhor, Kenya, have yielded some of the most important specimens in the primate fossil record. However, there has been little consensus concerning paleohabitats at these sites. Reconstructions of Rusinga habitats have ranged from semi-arid/open to rainforest settings; and Songhor is generally regarded as “forested” but the specific type(s) of forest are not known. The lack of widespread early Miocene C4 grasses, detectable by δ¹³C approaches, exacerbates the problem. Here we present dental microwear textures of tragulids from Rusinga Island (n=22; with the majority of specimens coming from localities R1 and R106, which date to between 18-20 Ma) and Songhor (n=14; with specimens dating to between 19.5-20 Ma) as a proxy for paleoenvironmental reconstruction of these early Neogene primate sites. Extant ruminants evince strong associations between microwear and habitat. Open-setting grazers tend to have low texture complexity and high anisotropy, whereas closed-forest browsers have high complexity and low anisotropy. The texture data for the tragulids from both sites fall within the range of extant bovid generalists, though Rusinga specimens have significantly higher complexity than do those from Songhor. These results are in accord with mixed habitat settings at these sites, with Rusinga exhibiting perhaps slightly more closed habitats than Songhor. Texture data distributions do not suggest marked changes in graze-browse ratios in seasonal environments.

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Hominin tool-making: laterality, language, and learning.

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The origins of language can be addressed through the proxy of right-handedness, which in humans occurs in about 90% of the species. *Homo sapiens* have the strongest lateral bias seen in any great ape. In order to trace the emergence and evolution of right-handedness, it is vital to obtain laterality data from hominins since the last common ancestor. One useful source of data is prehistoric stone tools, specifically traces of lateralised production and use.

This paper presents a critical analysis of several methods of identifying right-handedness in stone tools, using a combination of biomechanics, archaeological experiments, ethnographic parallels, and lithic analysis. Single-platform core rotation was not found to be validated, nor was the "coup de tranchet" knapping technique. The most robust archaeological evidence for prehistoric handedness was found in the lateralised resharpening of scrapers, which yield a 79% right-handed preference among the Neanderthal knappers at the site of La Cotte de St. Brelade, Jersey.

The results of this study show that Neanderthals are currently the earliest hominin species to show reliable evidence for species-level right-handedness. With this modern laterality indicating a proxy for linguistic ability, pre-modern Europeans can be considered quite modern in their language and cognition.

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Nuclear Magnetic Resonance of bone: a new method for investigation in anthropology?

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Nuclear Magnetic Resonance (NMR), well known in medicine thanks to Magnetic Resonance Imaging (MRI), can also make possible quantitative and qualitative studies of different materials from an atomical or molecular viewpoint. NMR has been weakly used for *in-vitro* bone analysis yet, although the technique is powerful, as it has been demonstrated in many other fields. It can indeed provide quantitative information on bones such as composition of the mineral or organic part, hydroxyapatite characterization, identification of amino acids in collagen, etc. Only 80-150 mg of bone are required for non-invasive analysis, *i.e.*, no chemical treatment is required. With all these advantages, NMR is a tool that should be investigated in physical anthropology and can give unique information.

As a first application, we have focused our study on the analysis of bones' collagen in order to follow its evolution as a function of i) time since death (from 2500 BC to 1990 AD) and ii) decomposition environments (buried; cremated; catacombs). Collagen was found in all samples whatever the post-mortem interval and the nature of environment. Preliminary analysis indicates that collagen contents decrease with time. Similarly, we found molecular evidences that the bio-hydroxyapatite, the main component of the mineral fraction of bone, evolved during time towards the chemical structure of pure hydroxyapatite. Such information could lead to use NMR as an alternative method for bone aging.

More generally, the use of NMR as a complementary tool in physical anthropology opens up new prospects for the study of bone composition and its implications.

Prehistoric population replacement on California's Channel Islands.

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Prehistoric population replacement on California's Channel Islands was investigated to determine if such an event occurred and if so at what point in time. This study was based on data gathered from the craniometric, mitochondrial DNA and carbon dating analysis of a previously unstudied skeletal collection (129 skulls) originating from the Channel Islands and coastal surroundings of Santa Barbara curated at the Musée de l'Homme in Paris (France). These remains were collected by Léon de Cessac between 1877 and 1879. The purpose of this research was to identify possible genetic groups who have occupied certain Channel Islands through time. Overall results indicate that we have at least two distinctive populations based on the craniometric and mtDNA data.

Size and skeletal development in early *Homo erectus*: a comparison of Nariokotome and Dmanisi.

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Previous analyses of the Nariokotome *Homo erectus* subadult skeleton have reached differing conclusions regarding the pattern growth and development in early *Homo* relative to that of modern humans. Additionally, uncertainty persists regarding the amount of growth remaining for the specimen and its likely adult stature. The discovery of a partial subadult skeleton from the Lower Pleistocene site of Dmanisi, Georgia, provides a unique opportunity to test ideas originally extrapolated from the study of the Nariokotome specimen about development and growth in early *Homo erectus*. Here we test the hypothesis that D2700 and WT15000 fit the same generalized developmental plan when compared to modern humans, as observed by patterns of skeletal fusion and dental eruption and wear. Our analysis suggests that the two specimens are consistent with a common developmental pattern, with the D2700 individual likely slightly further along in its course of development and/or female, compared to the male Nariokotome individual. This conclusion is an important step in developing a more nuanced perspective on the pattern of development and size variation in the early evolution of *Homo erectus*. Additionally, the similar patterns displayed between Dmanisi and Nariokotome make the discrepancies in size and proportion of the preserved limbs found within the two samples, particularly the lower limb, interesting points of query. We present and discuss further hypotheses for the nature and significance of these differences.

New perspective on the evolution of infectious disease.

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Developments in microbiology and genomics suggest it is time for a shift in perspective on human disease evolution. The traditional view as held by most anthropologists is that new human infections evolved via interspecies transfer of acute diseases from other animals, mostly during the Neolithic, with infectious disease, especially viral, of little importance to human evolution before this. This contrasts with recent work in microbial genetics indicating that a number of disease agents were ancient pathogens of hominins and in some cases the transfer was from humans to other animals. Also, recognition of the human microbiome and the observation that a substantial portion of the human genome is of viral origin further suggest that we shift the way we think about infectious disease evolution. Microbes, viruses, and other parasites were long-time inhabitants of hominin bodies, with diseases evolving through a waxing and waning of virulence as context and selection pressures (especially transmission opportunities) changed. Acute diseases evolved from persistent infections capable of being maintained in small populations and would have been abundant in all of our hominin ancestors. A number of examples are discussed.

Skill learning and the duration of development: the role of provisioning.

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In general, adult-level skills must be reached before the onset of reproduction. Using a large sample of birds and mammals, we show that immatures of species with more complex foraging niches (and larger brains as adults) take longer to reach adult skill levels than those with simple niches. This indicates a strong life history constraint on the evolution of skill-intensive niches. We then ask under which conditions species can nevertheless evolve into high-skill foraging niches, and distinguish two distinct, but non-exclusive pathways. First, among primates and other non-provisioning mammals, complex niches and large brains are found in lineages with extremely slow somatic development, which buys time for skill learning. Second, we show that immatures in other species with more complex foraging niches are supported through provisioning in the post-weaning or post-fledging period. Indeed, in cooperatively hunting species, adult skill levels can be reached well after the onset of reproduction. Humans are unique among primates in reaching adult skill levels well after reproductive maturity. This analysis shows that the evolution of our species' complex foraging niche was made possible because our ancestors, with extremely slow development due to their great ape ancestry, began to provide energetic support not only to mothers, but also to weaned immatures, as we evolved cooperative breeding and hunting.

Effects of seasonality on brain size evolution: evidence from nonhuman primates.

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Encephalization of early *Homo* has been proposed to be related to increasing seasonal conditions of its habitat. However, in primates, no evidence for a relationship between climatic seasonality and brain size evolution has been found. We argue that it is essential to distinguish between energetic costs and cognitive benefits of relatively larger brains, and consider them both. Using monthly dietary intake of 78 primate species, we show that the energetic constraints of periodic resource scarcity, inflicted by habitat seasonality, always correlate with relative brain size. Those species that suffer from periodic resource scarcity have relatively smaller brains. However, these energetic constraints can be counterbalanced by cognitively buffering the seasonality environment in some species. Those species that can keep their intake constant despite drastic variations in resource availability have relatively larger brains. However, not all conditions are equally favorable to evolve cognitive buffering. We found that a moderate degree of habitat seasonality needs to be present, and some amount of frugi- or insectivory, to allow for leveling of dietary intake through cognitive means.

Overall, this study shows the importance of incorporating both costs and benefit perspectives simultaneously in models on brain

size evolution. The evolution of early *Homo* in Africa is an example of how cognitive buffering can surmount energetic constraints. On the other hand, extreme periods of food scarcity may preclude the onset of cognitive buffering, e.g., in restricted island habitats like the one inhabited by *Homo floresiensis*.

Environmental influences on the activity patterns of a captive group of spider monkeys (*Ateles fusciceps rufiventris*).

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Previous studies indicate that many factors influence the activity patterns of social animals. It has also been shown that the proportions of species-typical behavior of captive animals can be increased through enrichment programs, and that increases in species-typical behavior patterns influence the success of reintroduction efforts of endangered species. Captive research provides a unique opportunity to explore the influences of intrinsic and extrinsic variables on the behaviors of animals. A captive group of spider monkeys (*Ateles fusciceps rufiventris*) maintained in an indoor and an outdoor enclosure was studied to determine if significant differences in behavior patterns occur between the two environments. Comparisons were also made to patterns seen in wild populations. Significant differences in behavior patterns were shown among all groups, though the outdoor behaviors were more similar to those seen in the wild. This may be due to the structural differences in the enclosures, as well as the effects of temperature and novelty. However, the effects of sex and age must also be accounted for in order to more fully understand these influences. Additionally, suggestions of enrichment are made to promote the species-typical behavior of this critically endangered species.

The Ford Cranial Collection: new online resources for research and education.

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Pathology and trauma affecting the skull and dentition are of interest to researchers in both bioarchaeology and medicine. Because many congenitally and environmentally acquired conditions are rare in the general population, they tend to be underrepresented in skeletal collections available for research or education. We have developed two new online resources to make a unique collection of pathological and traumatic crania available to a wider audience.

Dr. Corydon L. Ford collected 165 crania while he was Dean of the Department of Medicine and Surgery in the late 19th century. Dr. Ford sought crania of interest to use in anatomy courses. As such, the Ford Cranial Collection includes rare congenital conditions (e.g., microcephaly and achondroplasia) and

indicators of health and lifestyle (e.g., enamel hypoplasia and porotic hyperostosis). The collection represents both sexes and age groups ranging from infant to old adult.

We photographed and described each cranium and published them in the Ford Collection Database (<http://quod.lib.umich.edu/c/cranialic>). We also researched the causes of the symptoms observed in the skulls and published our literature reviews and accompanying bibliography in the Human Osteology Pathology and Trauma Wiki (<https://webservices.itcs.umich.edu/mediawiki/bonepath>). Both of these resources are useful tools for anthropological and medical research and education about the various conditions that can affect the skull and teeth and both are publicly available.

This project was funded and given technical assistance by the UM Instructional Support Services. The repository of the collection is the University of Michigan Museum of Anthropology, and lent to the Department of Anthropology.

Variation characterizes cooperative infant care in wild variegated lemurs (*Varecia rubra*) of Masoala, Madagascar.

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Few primates give birth to litters or build nests in which to care for them. Those that do are small-bodied, nocturnal and solitary. There is one enigmatic exception. Variegated lemurs (*Varecia*) are large, day-active, gregarious primates that bear litters in arboreal nests. Furthermore, they raise their young cooperatively and practice absentee parenting (infant stashing combined with oral transport of young). Till recently we lacked quantitative records of infant care. Observations, supplemented by canopy-level photography, were made in one population of *Varecia rubra* on the Masoala Peninsula, Madagascar. Data were collected on three litters and all care-givers during the first three months after birth (November 2010 - January 2011). Focal litter sampling determined which individuals provide care, how often, and of what type. Types of infant care of long duration were recorded at 5-minute time point intervals providing time budgets (e.g., guarding), while those of short duration were recorded on an all occurrence basis to obtain raw frequencies and hourly rates (e.g., infant transport). Simultaneously, focal mother sampling produced a record of maternal absence and activity when not in contact with young. Results demonstrate that litters benefit from costly forms of alloparental care, though rates and frequencies vary across helper age-sex classes. Furthermore, the total number of helpers varied enormously between litters; from one to over five. Four co-adapted traits appear to underlay the variegated lemur's ability to raise litters of non-clinging young while simultaneously relying on a patchily-distributed diet of ripe fruit: long-distance foraging, fission-fusion sociality, absentee parenting, and alloparenting.

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Sex differences in carious lesions in modern Maya populations: food consumption or else?

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Sex-related differences in carious lesions are often associated to resource access, although physiological factors are also deemed cariogenic. The present study analyzes caries in two Maya samples from two different socio-economic settings both in northern Yucatan: one from a globalized small town and a second one from a traditional Maya hamlet still characterized by native subsistence patterns and lifestyle. Both samples were equally grouped by sex and five-year age classes ranging from 15 to 30 years of age. Frequencies increase with age and female carious rates predominate over males in both cohorts. Overall rates of caries by sex and age are significantly lower in the native population in comparison with the urbanized group, despite the latter having better access to education, tooth cleaning devices, and odontological facilities, with the exception of the 15-20 years old native females that prevail over the same-aged urbanized females. In both cases, sex is not a limiting factor to resource access, so sex differences must be looked for in daily habits and physiological factors. Seventy percent of native women have their first offspring in the 15-20 age class after which they completely dedicate to household activities. Conversely, their small town's coetaneous girls usually complete high school and seventy percent have the first child in the 20-25 age class. Access to industrialized foods seems to be deleterious for oral health regardless of sex; however in the gender-related differences, physiological factors, daily habits and lifestyle play a major role in carious lesions within and between samples

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Genetic evidence of widespread differential selection for color vision among nocturnal lemurs.

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Color vision loss in nocturnal primates has been traditionally linked to a nocturnal lifestyle. However, recent work identified differential selection among nocturnal primates, with some species exhibiting selection to maintain dichromatic color vision at night. Our goals were to (1) determine the extent of differential selection on the S-opsin gene among nocturnal lemurs and (2) explore possible ecological factors driving differences in selection. We obtained DNA from wild individuals ($n=126$) representing 20 species and

5 genera (*Avahi*, *Lepilemur*, *Cheirogaleus*, *Microcebus*, *Phaner*), sampling populations from diverse habitats. We examined genetic signatures of selection at the population and lineage levels in order to estimate recent and more ancient selection pressures. At the population level, we compared the frequency, distribution and nucleotide diversity of replacement and silent mutations present within each population between congeners from different habitats. At the lineage level, we compared the ratio of replacement (dn) to synonymous (ds) substitution rates in coding regions between evolutionary lineages.

Our results suggest that differential selection on the S-opsin gene is widespread across nocturnal lemurs. Most variation is found between congeners, with some populations exhibiting evidence of purifying selection to maintain function while others exhibit relaxed selection and possible S cone loss. Comparing population and lineage results suggests this relaxation is relatively recent for many lineages. Habitat preference (open-canopy vs. rainforest) appears to influence selection in some genera. These results provide further evidence that many nocturnal primates maintain functional color vision, suggesting that specific ecological factors favor dichromacy even at nocturnal light levels.

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Energetics and biomechanics of humans climbing trees for honey.

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Honey is an important resource for hunter-gatherers in both rainforest and savanna habitats. It is a high-calorie food and commodity, but it can be dangerous to acquire, often necessitating extraordinary tree-climbing abilities. Yet the mechanics and energetic costs of human tree climbing have received little attention. Here we use portable respirometry (Oxycon Mobile) to evaluate the energetic costs of tree climbing by Twa (pygmy) hunter-gatherers living in southwest Uganda. We found that the energetic cost of vertical climbing was sevenfold higher than resting and threefold greater than walking through dense undergrowth. To explore how the high cost of climbing might be mitigated anatomically, we examined ankle joint kinematics during climbing and used portable ultrasound (MicroMaxx) to estimate the physiological cross-sectional area (PCSA) of the gastrocnemius muscle. We found an average ankle dorsiflexion of 36.4 (+/-2.18) degrees. The maximum observed values (>46 degrees) exceed the limits at which soft tissue failure is thought to occur. Such extreme dorsiflexion appears to enable a climber to position his mass closer to a tree and thus reduce his energy expenditure. We

also found that the relative PCSA of the gastrocnemius was significantly lower ($p<.05$) among the Twa than their Bantu neighbors, indicating a force-limited but more excursive muscle. Taken together, these findings can be interpreted as energy-saving adaptations. A lower PCSA is expected to reduce metabolic costs as well as the mechanical costs of extreme dorsiflexion. Our results implicate tree climbing as a selective pressure for some derived aspects of the human pygmy phenotype.

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Human hand function and dysfunction: what insights can be gained from comparative anatomy and musculoskeletal computer models?

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Human hands have a relatively long and strong thumb, allowing precise manipulation and powerful grasping. Several hypotheses have been posited to explain the evolution of these unique prehensile capacities, with as most important components stone tool use, habitual bipedalism and throwing. While great apes also use their hands in these contexts, their hands retain an important locomotor function. Recent fossil findings have contested the gradual change in hand morphology from ape-like to *Homo*-like, and suggested that several hand 'morphotypes' may have existed. While the scarce nature of hominin fossils limits reconstruction of evolutionary processes, valuable insight can be gained using computer models of primate hands.

Our study focuses on the basal thumb joint, which plays a crucial role in manipulation yet is also particularly prone to pathologies, such as osteoarthritis. While osteoarthritis also occurs in the hands of nonhuman primates, its prevalence is much lower and a gender bias – as found in humans – is debated.

Different medical imaging techniques were used to collect the geometry and kinematics of the thumb in cadaveric hands. These data were integrated with available anatomical data from literature and used to build a musculoskeletal thumb model. In a next step, forward modeling will be implemented to allow evaluation of the functional implications of anatomical variations. This will help to elucidate evolutionary processes, as well as improve our understanding of the development of osteoarthritis. This symposium provides a suitable platform to discuss preliminary results, evaluate used approaches and define best practices and future perspectives.

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Genetics of caries.

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Data on caries prevalence suggest that women may experience more carious lesions. There is evidence for a genetic component in caries susceptibility, and studies in humans show linkage and association between loci on chromosome X and caries experience. Linkage with autosomal loci also may explain why women may be more susceptible to caries. This presentation will describe candidate gene and genome wide approaches aiming to identify genetic factors contributing to caries that may ultimately explain why there are gender differences in caries experience. Our preliminary data points out to loci on the X chromosome, including the locus of the *amelogenin* gene, which is involved in tooth enamel formation and is differentially expressed in males versus females. Also, we have suggestive linkage data implicating 14q24.3, close to *ESRRB* (estrogen-related receptor beta). This gene encodes a protein with similarity to the estrogen receptor. Its function is unknown; however, this gene is likely to have diverse biological functions. One can argue that a gene with estrogen-related function could also contribute to the observed gender differences in caries frequency. Estrogens have been known to have a depressing effect on the secretion of growth hormone from the anterior pituitary. Growth hormone is closely related to the development and maintenance of normal histologic structure of salivary glands, the function of which, in turn, might influence caries formation.

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Reliability of classic scoring methods for age estimation of pelvic bone applied to CT and laser scans.

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CT and laser scanning technologies are increasingly used in anthropology, mainly for personal identification and the estimation of race and sex. Recent studies have demonstrated the potential of CT-scans for age estimation by analyzing the pelvic bone. However, applications of laser scans to the problem of age estimation of the pelvic bones are much scarcer. We investigated how the morphological features of the pelvic bone surface can be described and scored on 3D datasets from CT and laser scans of a sample of 12 male pubic symphyses from cadavers and 8 auricular surfaces selected from the original reference set used for developing the Buckberry and Chamberlain (2002) method. The 3D datasets produced by the laser scanner have a better resolution than those produced by the CT-scanner, but not enough to see all features that can be observed on dry bones. It is not possible to recognize taphonomic alterations from morphological changes without additional information as for example the use of a high-

resolution picture of the bone. Features such microporosity and macroporosity cannot always be correctly evaluated in laser scans and are even more difficult to identify in CT scans. The difference between a finely granular surface and a coarsely granular surface can not be scored. Billowing and transverse organization can be identified but the degree of expression is difficult to evaluate. In conclusion, we suggest that the classic scoring methods of the pelvic bones need to be modified and reimplemented before they can be applied to such 3D datasets.

Medial versus lateral epicondyle enthesopathies through time: implications for behavioural reconstruction.

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In living people enthesopathies of the lateral epicondyle of the humerus are far more common than for the medial epicondyle. Interestingly, a comprehensive review of the anthropological literature regarding these two conditions indicates a similar pattern.

Our goal is to present and discuss the relative occurrence of medial versus lateral epicondyle enthesopathies for about 1000 European skeletons dated from 25 thousand years ago to the beginning of the 20th century. A single observer (S.V.) performed all entheses examinations employing the same methodological criteria.

Enthesopathies of the lateral epicondyle are more common, for both sides and both sexes, in all historical samples. On the other hand, in prehistoric samples dated from the Upper Palaeolithic, the Mesolithic and the Neolithic, medial epicondyle enthesopathies are more common than lateral epicondylar ones, but only in males and only for the right side.

This observation of this diachronic pattern provides a strong argument for considering a mechanical origin for these lesions. Medial epicondyle enthesopathies, then, represent a valuable osteological marker for throwing motions. Based on this evidence, we argue that a predominance of medial epicondyle enthesopathies compared to lateral epicondylar ones in a given sample may be a valuable indicator of specific behavioural patterns.

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The scaling of maximum jaw-opening ability in primates.

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The ability to open the jaw widely has significant functional consequences for primate feeding and social behaviors. We measured maximum jaw-opening ability, or maximum gape, in 765 adult male and female anesthetized/cadaveric individuals representing 63 primate species to examine patterns of allometry in this performance measure. Reduced-major axis (RMA) regressions of combined sex samples indicate that maximum gape scales with slight negative allometry (slope=0.95) relative to body mass^{0.333} and slight positive allometry relative to jaw length (slope=1.11) across primates, although isometry is not ruled out in either case. Relative to basion-nasion length, maximum gape scales with positive allometry (slope=1.4). Maximum gape scales with negative allometry relative to antero-posterior condyle length (slope=0.89) and near isometry relative to glenoid length (slope=0.99). The functional implications of these scaling patterns suggest that relative increases in gape tend to follow from relative increases in condylar curvature (as estimated by AP condyle length) and relatively decreased contributions from jaw length across primates. While anthropoids and strepsirrhines show no differences in scaling patterns relative to body mass, maximum gape in anthropoids is transposed above strepsirrhines when regressed against either jaw length or basion-nasion length. This transposition along with the positive allometry and tendency for anthropoids to be larger than strepsirrhines all contribute to the relatively larger gapes of anthropoids compared to strepsirrhines when evaluated against craniofacial measures. Documenting the allometric relationships between maximum gape and other masticatory measures will provide a baseline for interpreting variation in this performance measure in specific primate groups.

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New Neanderthal remains from Chagyrskaya Cave (Altai Mountains, Russian Federation).

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In 2007, Krause and colleagues published Neanderthal-like mitochondrial DNA sequences from hominin remains found at Okladnikov Cave in the Altai Mountains (Russian Federation).

Partly due to their fragmentary nature, the Okladnikov remains lack derived Neanderthal traits.

Since 2007, one of us (SVM) leads the excavation of a new, rich Middle Palaeolithic site - Chagyrskaya cave in the Charysh Valley, about 70 km southwest of Okladnikov Cave. The deposits yielded a Mousterian industry of the Sibiryachikha tradition, very similar to Okladnikov cave. Absolute dating of the site is in progress, but biostratigraphic data indicate that the material probably belongs to the Karginian interstadial (OIS 3). Besides the industry and a rich faunal collection, several hominin remains were also recovered in Layer 6b and 6v.

The specimens from Layer 6b are a small worn upper deciduous canine, and an atlas fragment of a 3-5 year old child, none of which is very diagnostic. The material from the underlying horizon 6v includes an upper P⁴ fragment and a lower incisor worn to the cervix. Both are small, and have very short roots.

In 2011, we found a partial mandible including the right corpus and C-M₂ in Layer 6v. This specimen shows several derived Neanderthal traits, including continuous midtrigonid crests on the M₁ and M₂, a strongly asymmetrical P₄, a p₄ posteriorly placed mental foramen and an oblique mylohyoid line. Thus, this specimen allows us for the first time to morphologically link material from the Altai to Western Eurasian Neanderthals.

3D geometric morphometrics of the LB1 mandible support the new species diagnosis (*Homo floresiensis*).

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Debate continues over the systematics of the Late Pleistocene fossils from Liang Bua (Flores, Indonesia). The designation of the holotype (LB1) as a new species, *Homo floresiensis*, has been contested by some who believe that the morphology of this fossil falls within the range of variation seen in pathological humans. Here we present a three-dimensional, landmark-based morphometric study of the LB1 mandible in order to assess if its shape is ever observed within a large sample of modern humans that includes pathological individuals diagnosed with microcephaly and cretinism.

Data were collected from mandibles of 250 non-pathological modern humans, 8 microcephalics, 6 cretins and 9 fossil hominins. Principal components (PC) of shape were extracted, and a canonical discriminant analysis (CDA) based on the first five PCs was performed after dividing the comparative samples into 3 groups: non-pathological, pathological, and fossil hominin. LB1 was treated as an unknown.

The CDA classified LB1 as a member of the fossil hominins with a 99% probability of group membership. LB1 had a 1% probability of being classified as a normal modern human, but

a 0% probability of being classified as pathological. Morphology of the LB1 mandible is therefore most similar to that observed in other hominin fossils, whereas microcephalic and cretin mandibles extend the modern human shape space away from the fossils. These results allow one to firmly reject the pathological modern human hypothesis, lend strong support to the recent conclusions of Brown and Maeda (2009), and corroborate the new species diagnosis for LB1.

This project was funded by a National Science Foundation Graduate Research Fellowship and the Australian Research Council.

Is genetic variation a source of individual and populational differences in ovarian hormone concentrations?

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There is ample evidence of substantial inter-individual and inter-populational variation in the average concentrations of progesterone and estrogens in pre-menopausal women. But despite the prominence of ovarian functioning in models of human life history adaptations and the large body of work demonstrating that steroid concentrations are significant risk factors for breast and other cancers, little is known of the factors generating this hormonal variation.

Because energetic stressors influence temporal (inter-cycle) hormonal variation within an individual, it has been argued that energetic factors are principal determinants of natural (non-pathological) variation in hormone concentrations between individuals and populations. However, energetic stressors cannot readily explain the entirety of the substantial non-pathological variation in ovarian steroid concentrations within any single population nor the high progesterone concentrations in nomadic herders, who have relatively low energy intake and heavy workloads. These observations suggest that factors other than energetic stressors also generate significant natural variation in hormone concentrations.

In the present study, using data collected from pre-menopausal women drawn from three populations, we test the hypothesis that variations in the genes coding for the enzymes acting in steroid biosynthesis and metabolism are significant contributors to within and between populational variation in ovarian steroid levels. A finding that genetic variation is associated with substantial variation in hormone

concentrations would raise questions regarding how the genotypic variation interacts with temporally and spatially varying environmental stressors, how evolutionary processes might have shaped this genotypic and phenotypic variation, and whether the variation is adaptive in one environment or another.

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Variation in the nutritional quality of the diets of two populations of Bornean orangutans (*Pongo pygmaeus wurmbii*): implications for population density.

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Understanding the factors that contribute to variation in primate population density is of primary concern for conservation efforts. Recent studies of dietary and nutritional ecology in wild primates have demonstrated that great intra-specific variation can exist between nearby populations. We compared the nutritional quality of the diets of two Bornean orangutan populations, in the Tuanan and Sabangau peat-swamp forests, separated by 52 km. We hypothesized that the nutritional quality of food resources at Tuanan would be higher, as Tuanan is more alluvial, whereas Sabangau is entirely ombrogenous. We collected samples of food items consumed by orangutans at both sites, and analyzed them in the same laboratory using standardized nutritional chemical analysis. To calculate energy intake rates for each site, we analyzed over 10,000 hours of focal data collected between 2003 and 2009. Both total energy and metabolically energy of dietary items are significantly greater at Tuanan compared to Sabangau (n= 215, 183; p=0.02 and p<0.0001 respectively). Dietary items at Tuanan are significantly higher in lipids and total non-structural carbohydrates (TNC), but lower in neutral-detergent fiber (NDF). To examine this relationship more thoroughly, we compared those species that are consumed at both sites using non-parametric matched tests. Metabolically energy, crude protein, TNC, and energy intake rate values were all higher at Tuanan, while NDF values were higher at Sabangau. These differences in dietary nutritional quality may provide insights into why orangutan population density is two times greater at Tuanan compared to Sabangau, and attest to the importance of distinguishing peat-swamp forest types.

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Mortuary practices of a medieval cemetery in southern Italy.

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Apigliano is a medieval peasant village located in southern Italy that contains a small church with stone-lined tombs and charnel pits both within and surrounding it. The commingled nature of the skeletal remains within these burial features suggests that tombs were reused for subsequent burials. Once filled, an adjacent charnel pit was to be used as a repository to make room in the tomb for future burials. Each of these burial features is believed to represent a family unit. To test this hypothesis, paleodemographic methods were used to determine whether the assemblages in each burial were comprised of a mixture of males and females of various ages consistent with a family grouping.

The second research goal was to examine whether differential burial practices according to age at death were present. It is well documented that burials within churches during this period were reserved for subadults as well as individuals of status within the community. Although the residents of Apigliano were all known to be peasants, demographic analyses were used to determine if there were age biases in these burial practices.

Our results indicate that each burial feature contains assemblages consistent with family groupings supporting the hypothesis of familial tombs. Analyses of preferential burial practices revealed no significant differences between burial features outside of the church, suggesting this space was available to everyone. However, there were significant levels of subadults found interred within the church and directly surrounding the church demonstrating preferential burial in these sacred places.

Endostructural conformation and properties of the Neanderthal La Ferrassie 2 tibial plateau.

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Relative to extant humans, the Neanderthal lower limb skeleton exhibits greater

diaphyseal robusticity, which is consistent with a higher level of mechanical loads experienced throughout life. The adult tibial diaphysis is reported to have thickened cortical bone and greater strength in the medio-lateral plane. At the knee joint, the distribution of the cortico-trabecular complex (CTC) beneath the tibial plateau indicates bone reinforcement at both condyles compared to the modern condition.

As the structural organization and textural properties of the cancellous bone provide direct information about the nature, direction, and magnitude of the habitual loads, we have assessed the still unreported pattern characterizing the trabecular network underlying the Neanderthal tibial plateau in the right specimen La Ferrassie 2 (France).

By using a synchrotron radiation microtomographic record realised at the ESRF medical beamline ID17 of Grenoble (45.5×45.5×43.6 µm voxel size), we have quantified the parameters of bone volume fraction, degree of anisotropy, and trabecular thickness topographic variation in a selected number of regions (ROI) and volumes (VOI) of interest under the CTC of each condyle.

Immediately below the cortical shell and along the coronal plane, this young adult Neanderthal plateau shows a layer composed of relatively and absolutely thick trabeculae, significantly thicker than those measured at homologous sites in the modern human sample available to us. This transitional layer overlaps a more finely structured/oriented trabecular network.

Our analysis shows that the medial condyle records a preferential strengthening of the cancellous pattern expressed by a greater density and degree of anisotropy.

An analysis of global human mandibular variation in the context of agricultural versus hunter-gatherer subsistence strategies.

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Variation in the masticatory behavior of hunter-gatherer and agricultural populations is hypothesized to be one of the major forces affecting human mandibular form. However, this has yet to be analyzed at a global level. Here, the relationship between global mandibular shape variation and subsistence economy is tested, while controlling for the potentially confounding effects of shared population history, geography and climate. Materials comprised matched genetic, morphometric, geographic, climatic, and subsistence data collated for eleven globally distributed human populations. Morphometric data included configurations of landmarks for the mandible, and for three regions of the cranium involved in mastication (insertions of the temporalis muscles, the zygomatic-temporal region and the palate-maxillary region) as well as two non-masticatory regions (the vault and basicranium). Data were analyzed using full and partial Mantel tests.

The results demonstrate that the mandible, in contrast with cranial regions, significantly reflects subsistence strategy rather than neutral genetic patterns, with hunter-gatherers having consistently longer and

narrower mandibles than agriculturalists. These results support notions that a decrease in masticatory stress among agriculturalists causes the mandible to grow and develop differently. This developmental argument also explains why there is often a mismatch between the size of the lower face and the dentition, which in turn leads to increased prevalence of dental crowding and malocclusions in modern post-industrial populations. Therefore, these results have important implications for our understanding of human masticatory adaptation.

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Date estimates for major mitochondrial haplogroups in Yemen.

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Yemen occupies a key location as the first stop for anatomically modern humans on a theoretical southern migration route out of Africa. If modern humans did pass through Yemen during the first migrations out of Africa and if they left modern-day descendants, we would expect to see deep divergences in the Yemeni mitochondrial gene tree. Alternatively, if modern humans passed through Yemen but did not leave modern-day descendants or if Yemen was not on the path of these ancient migrations, we would expect more recent dates to be associated with Yemeni mitochondrial haplogroups.

Using 44 previously sequenced mitochondrial genomes as well as 24 newly sequenced mitochondrial genomes from samples collected throughout Yemen, several methods were used to estimate divergence dates of major Yemeni haplogroups including L2, M, R0a and HV. Specifically, phylogenetic trees were generated using MrBayes and maximum likelihood methods. Bayesian and ρ statistic based methods were used to estimate dates of Yemeni haplogroups and these dates were compared with each other, previously published dates for these haplogroups, approximate dates of climatic change that might be expected to correlate with population expansions, and estimates based on archaeological and paleontological evidence for the first migrations out of Africa. These comparisons are intended to cover the range of possible haplogroup divergence dates with respect to the history of early modern humans in southern Arabia.

Examining the evolution of Egyptian exerebration and evisceration through the IMPACT mummy database.

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Mummification is a purification and reassembly of the person of the deceased – metaphorical and magical. Features of the embalming traditions, specifically the variable excerebration and evisceration traditions, represented the Egyptian view of death; one of transition to a second, potentially more enjoyable, life.

Firsthand access to imaging studies of these traditions on a large scale has recently been made possible through the development of a radiological mummy studies database. The IMPACT Radiological Mummy Database is a large-scale, multi-institutional collaborative research project devoted to the scientific study of mummified remains through primary data from medical imaging modalities.

The first application of IMPACT addresses the evolution of Egyptian excerebration and evisceration, and how suites of features in mummies of differing age, sex, status, and location differ and relate to the fate of the recipient's afterlife. The origins, temporo-spatial trends, and status associations of these features are discussed relative to documented sociopolitical and ideological changes and interactions.

Egyptian mummification and funerary rituals were a transformative process, making the deceased a pure being; free of disease, injury, and disfigurements, as well as ethical and moral impurities. Consequently, the features of mummification available to specific categories of individuals hold social and ideological significance. This study presents unique, hybrid feature suites; refutes long-held classical stereotypes, particularly dogmatic class associations; and expands on the purposes of excerebration and evisceration implied by previous studies.

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Morphological correlates of human hip osteoarthritis.

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Osteoarthritis (OA) is a degenerative joint disease promoted by a diverse array of genetic, somatic, environmental, and temporal factors. Approximately 27% of the American population suffers from OA of the hip, but signs of OA are rare in the hominin fossil record. It has been hypothesized that joints most commonly affected by OA, including the hip and knee, are those that have evolutionarily undergone significant morphological change increasing loading. Few morphological risk factors for OA in modern humans, however, have been determined. Recent research has suggested that gross morphological deformity of the hip predisposes the joint to OA in later life. Minor variation in hip morphology may have no

functional ramifications, but could influence the biomechanics of the joint, altering the load and potentially fostering OA. In the present study, 115 radiographs of patients suffering from OA of the hip were examined and biomechanically relevant metrics were recorded. In patients with one affected hip, femoral biomechanical neck length and neck-shaft angle were significantly bilaterally asymmetrical. Relative biomechanical neck length, relative femoral head diameter, and neck-shaft angle were also significantly different between the pathological and control samples. These data suggest that subtle morphological variation in the hip influencing loading patterns are correlated with hip OA and indicate that modern humans may be more predisposed to OA than australopiths and Early *Homo* as result of increased joint reaction forces associated with the modern morphology.

Calcification of osteons in a sample of twentieth century Americans.

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Undecalcified thin sections were prepared from bone plugs from the anterior midshaft right femur from 105 human specimens of both African (46 males, 27 females) and European (13 males, 19 females) ancestries, aged 18 to 68 years. Specimens are from the Hamann-Todd Collection, and died between 1910 and 1940. Sections were cut at 50 microns, and x-rayed before mounting for histological study. Numbers of poorly calcified secondary osteons per sq. mm. (PCSOSM) were quantified. Among males there is a low but significant positive correlation with age. There is not a correlation with age among females. Females demonstrate a significantly higher density of PCSOSM than males. There is no significant difference in total secondary osteon density between males and females. Therefore the proportion of secondary osteons that are poorly calcified is greater among females than males. There are no significant differences due to population of geographic origin. High PCSOSM can be indicative of rapid remodeling, as young osteons are less calcified than older ones. However, high PCSOSM can also be indicative of nutritional stress. This is particularly true among females who may be pregnant or lactating. This may account for the significantly higher PCSOSM among Hamann-Todd females.

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Is female morphology selected for economy and male morphology selected for efficiency? Evidence from studies on humans.

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Female humans are typically smaller than males with relatively broader pelvises. While these sexually dimorphic characters are touted as adaptations for successful child-carrying and birthing, their interaction with other survival necessities must be considered. Particularly,

locomotor and thermoregulatory costs are influenced by sexually dimorphic traits such as body size. We compare data on males (N=10) and females (N=9) walking at four self-selected speeds, while oxygen consumption and core temperature are monitored, in order to assess morphological components that differentiate economy (cost/time) and efficiency (cost/distance) in the context of movement-related thermoregulatory challenges. Males had significantly larger masses and lower limb lengths ($p < 0.03$), and relatively narrower pelvises ($p = 0.13$). Optimal walking curves were calculated for each individual. Mean core temperatures at rest were subtracted from the mean at each walking speed to assess changes in core temperature during activity. Males had faster optimal walking speeds (10.9%, $p = 0.02$), higher costs at the optimum (23.4%, $p = 0.002$), and increased curvature (22.1%, $p = 0.28$) of their optimal walking curves. While there were no significant differences in core resting temperatures ($p = 0.52$), males showed a larger increase in body temperature (36.9%, $p = 0.14$) during activity. Females' slower walking speeds, reduced metabolic costs and smaller masses indicate females are generally more economical walkers than males. Keeping heat loads down is essential for successful reproduction. These data suggest that females' small size promotes heat loss while slow speeds prevent excessive heat gain. Increasing heat load by adding subsistence or child burdens may cause females to face a conflict between economical and efficient walking speeds.

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Inferring hominin activity levels from limb bone remains: insights from a mouse model.

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To reconstruct the activity levels of hominins living in the past, anthropologists infer functional loading history from the morphology of limb bone remains. It is assumed that, during life, loading had a positive (anabolic) effect on bone structure that largely overruled other influences such as genetic background. In this study, we investigate the relative influence of genetic background and functional loading on limb bones using four genetically distinct lines of mice that had been selectively bred for high levels of voluntary wheel running. Growing males from each line were either allowed or denied access to wheels for two months. At the end of the experiment, femoral morphology was assessed using micro-CT at two cortical sites (mid-diaphysis, distal metaphysis) and one trabecular site (distal metaphysis). We found that genetic background (line) had a highly

significant effect on all cortical morphological indices analyzed and most trabecular indices. Voluntary wheel running had only a minor influence on bone morphology, and the functional response did not result in enhanced structure. In the mid-diaphysis, running caused significant endocortical expansion and thinning of the cortical walls, and an almost significant reduction in bone area. Thinner cortices were also observed in the metaphyses of runners. Trabecular morphology was unaffected by running. These results underscore the strong influence of genetic background on limb bone structure and the complexity by which mechanical stimuli may cause alterations in it. This study suggests that prudence is necessary when limb bone remains are used to glean information about ancient hominin activity.

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The utility of anterior femoral curvature as an indicator of mobility.

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Anterior femoral curvature (AFC) has recently been proposed as a biomechanical indicator of terrestrial logistic mobility. Initially suggested as a forensic technique for racial identification, several analyses have demonstrated patterns of decreasing femoral curvature through time, consistent with expectations of decreased mobility during the transition to sedentism. Consensus for why AFC would vary with mobility is lacking, and attempts to correlate AFC with other behavioral indicators have yielded weak results. We investigated this relationship by examining the correlation between AFC and cross-sectional geometry using 50 femora from the Campbell Site (23PM5), a Late Mississippian site located in southeastern Missouri. Latex casts and biplanar radiographs of the femoral mid-shafts were taken to determine cross-sectional properties, while position and amount of maximum curvature was measured using chord length and a millimeter grid. Femoral head diameter and bone length were used to standardize for body mass. Our results indicate that a relationship exists between body-size corrected bowing index and femoral anteroposterior bending strength (I_x) and maximum bending strength (I_{max}). We also demonstrate that AFC and cross-sectional geometry present similar results for investigations of the sexual division of labor. This project enhances our current understanding of AFC as an indicator of mobility, and indicates that it is useful as part of a multiple-indicators approach to reconstruction of prehistoric patterns of mobility.

Naton Beach site: an examination of the skeletal remains of prehistoric Pre-Latte and Latte burials.

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The Naton Beach collection includes 172 Pre-Latte burials and 265 Latte burials. The size of the collection and systematic recording of the skeletal information provides a major contribution to the human biology of the region. Paleodemographic data, dental and skeletal morphology, and paleopathologic information is presented along with a description of some of the cultural differences between the two groups. The life expectancy for the Pre-Latte is 25.7 and 23.8 for the Latte. However, there was an under-representation of subadults in the Pre-Latte group. Both groups had a ratio of males to females that is nearly 1:1. The dental morphology indicates that the teeth of the Pre-Latte are significantly larger than those of the Latte and have different frequencies of key dental nonmetric traits. Skeletal morphology is similar in the two groups; one exception is a significant difference in the shape of the male femurs (anterior-posterior below the subtrochanter and at midshaft) between the Pre-Latte and Latte. A greater number of pathological conditions were observed on the Latte and more Latte individuals have pathologies recorded compared to the Pre-Latte. Yaws is observed on the Latte but not on the Pre-Latte. Cultural differences were observed in the dental remains. The Pre-Latte have a unique labial abrasion pattern on the upper anterior dentition that is not seen in the Latte. The Latte have betel nut-stained teeth, a trait which is not observed in the Pre-Latte. The data from this site offer a unique opportunity to better understand the earliest occupants of Guam.

Sensitivity of nonlinear elastic properties of zygomaticotemporal sutures in a macaque cranial Finite Element Model.

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Sutures with varying linear elastic properties have been tested using Finite Element Analysis (FEA) and have demonstrated limited impact on global skull mechanics. However, sutures behave nonlinearly during compression and tension. Due to the interdigitated configuration of the suture-bone interface, sutures have a higher material stiffness in tension than in compression. We hypothesized that the assignment of nonlinear homogeneous material properties would render more realistically behaving FE sutures. Nonlinear isotropic elastic material properties (E Tensile = 74MPa, E Compressive = 27 MPa. From Popowics and Herring 2007) were assigned to the zygomaticotemporal sutures of a juvenile Rhesus macaque FE model and tested using nonlinear static simulations. Global strain patterns for the

nonlinear models were comparable to models using linear elastic suture properties (E=17.3GPa, E=50MPa, and E=1MPa). Strain patterns within the nonlinear sutures were most similar to the E=1MPa linear model, suggesting limited influences of nonlinear elastic properties. However, strain modes within the sutures differed among all models. For example, up to 32.6% of sutural elements underwent changes in their strain mode (from compressive-dominant to tensile-dominant, or vice versa) from the nonlinear model to the 1MPa linear model. As strain modes in sutures are closely related to sutural placement and complexity (Herring and Mucci 1991), the change in sutural elastic properties during growth, functional adaptation, and fusion may have significant biomechanical consequences. These findings warrant further study of sutural morphology and its interaction with biomechanics at a microanatomical level.

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Hip abductor force production as a contributor to locomotor cost.

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The effect of pelvic shape and hip abductor mechanics on locomotor cost has long been debated. However, the contribution of hip abductor force production to overall cost during walking and running has not been established. Recent studies have demonstrated the volume of muscle activated during stance phase is a better predictor of locomotor energetics than other cost determinants. The purpose of this study was to establish the individual contribution of the hip abductors and extensor muscles of the lower limb to locomotor cost. Twenty-six subjects participated in biomechanics testing including force plate and oxygen consumption trials. Anatomical data was determined from full lower body MRIs of each subject. Active muscle volumes in four muscle groups, the hip abductors, hip and knee extensors and ankle plantarflexors, were calculated from joint torques determined by inverse dynamics. Summed active muscle volume ($\text{cm}^3 \text{kg}^{-1} \text{m}^{-1}$) of the extensor muscle groups explains 86.9% of the variation in mass specific cost ($\text{mlO}_2 \text{kg}^{-1} \text{m}^{-1}$) during locomotion ($P < 0.001$). Adding the hip abductors to the model increases explained variance by 1%. This small increase is explained by the high correlation of active muscle volume between each muscle group. However, the hip abductors account for 15% of the total active muscle volume of the lower limb during walking and running suggesting a significant contribution to overall cost. Despite being dimorphic in several measures of the body and pelvis, there were no differences between males and females in mass-specific active muscle volume or locomotor cost at any speed.

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Sex differences in periodontal disease and caries in a Portuguese identified skeletal

sample from the late nineteenth and early twentieth centuries.

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Archaeological studies frequently fail to consider sex when reporting oral diseases in past populations. In those studies where this has been attempted, men were found to be more affected by periodontitis and less prone to caries than women. If this is so then, where both sexes are combined together, it is implicitly assumed that they have an equal chance of being recorded, in all assemblages studied. This is not the case for most archaeological collections, which often have fewer than expected female skeletons.

The aim of this study is to compare data derived from skeletal samples with statistics compiled from epidemiological studies to determine if sex is essential or not to account for in future archaeological studies.

Periodontal disease and caries were investigated in 600 individuals belonging to the identified skeletal collections of the University of Coimbra, Portugal.

Periodontal status was assessed based on the textural and architectural variations of the interdental septum and the extent of bone loss. Dental lesions were judged to be caries if there was a discernable white or brown spot in the enamel.

Men were more susceptible to periodontal disease than women. Not only did men have less healthy areas than women, but they also showed more sites with gingivitis and periodontitis.

Higher caries rates were observed in females than in males for upper teeth. No differences were found between the sexes for lower teeth.

Coimbra results were similar to comparable modern epidemiological surveys, making clear the importance of considering sex in future archaeological studies.

The effect of climatic conditions on burnt bone fragmentation.

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This research aims to assess how climatic conditions, such as temperature and rainfall, affect the fragmentation of burnt bone. Recovery of remains from fatal fire scenes is often hampered by the fragmentary nature of the material and though understanding how climatic conditions affect this fragmentation it may be possible to adjust recovery timelines and protocols to maximise the quantity and quality of material recovered. This data is also valuable as a baseline for expected fragmentation, and expected differences in fragmentation, under different climatic conditions.

Sus scrofa forelimbs were burned in a series of wood fires over a period of eight months from winter through to fall. Limbs from younger and older individuals were recovered after cooling overnight and additional limbs from older individuals were recovered at subsequent

delay periods of 24 hours, 56 hours and 168 hours (1 week). Bone fragments were sorted by size and the proportional weight of each category compared to observe differences in fragmentation. Preliminary results suggest that following immediate recovery cold weather and freezing conditions increase fragmentation in younger remains but not in older remains. In the delayed recovery series cold weather and freezing conditions resulted in steady increases in proportional weight with increasing category size, whereas in temperate, wet conditions proportional weights increase in a stepped pattern with mid-sized categories showing similar levels.

The interaction of reproductive physiology and biocultural ecology: a comparison of prehistoric oral pathology in two American deserts.

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Caries and tooth loss were recorded in 200 Formative period (1500 B.C.-A.D. 500) skeletons from the Atacama Desert in northern Chile and 142 Early Agricultural period (1600 B.C.-A.D. 150) skeletons from the Sonoran Desert in northwest Mexico to compare how differences in local ecology and subsistence practices interacted with sex-based differences in oral pathology. The archaeological periods represent the transition to agricultural dependence in both areas, but rich local ecologies facilitated a mixed subsistence strategy—based on marine resources along the Atacama coast and a diversity of edible succulents in the Sonoran inland. Applying the theoretical approach that reproductive physiology among women negatively affects patterns in oral health, caries and antemortem tooth loss were compared between sexes by age, between regions. Results identify a marked distinction between the severity and progression of carious lesions compared to tooth loss between males and females. Caries rates were higher and more variable in the Chilean sample and therefore subject to differences in subsistence practices. Tooth loss however, which is further influenced by alveolar bone density, oscillates in severity by subsistence practices but maintain an age-progressive pattern that affects women differentially as a result of the connection between lifelong hormonal fluctuations and bone loss. These findings highlight the complicated etiology of oral disease, particularly in past populations, and imply that the interplay between oral bacteria, reproductive physiology, and biocultural ecology shape differential patterns in oral pathology.

Associations between dominance rank, grooming network strength, and centrality among male chimpanzees at Ngogo.

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Social network analysis provides powerful tools for analysis of primate social

dynamics and is increasingly employed to this end. We used social network analysis implemented in UCINET to test several hypotheses about the distribution of grooming among adult male chimpanzees in an unusually large community at Ngogo, Kibale National Park, Uganda during four study periods. We used interaction matrices in which entries were dyadic grooming times to construct directed networks, weighted to account for variation in sampling time, and calculated in-strength and out-strength (measures of centrality in a network) for each individual. Results of matrix permutation tests ($n = 1000$ permutations) showed that the association between in-strength of grooming (the total strength of all grooming connections involving grooming received from others) and male dominance rank was significantly positive in all study periods, but that associations between rank and the out-strength of grooming (total strength of all connections involving grooming given to others) were inconsistent. Bonacich centrality values, which measure the summed connections of each individual to others, weighted by the others' centralities, were also positively correlated with dominance rank. These results confirm earlier reports from Ngogo and elsewhere that high-ranking males were attractive grooming targets, although they did not necessarily groom others to corresponding degrees, and indicate that high-ranking males were more central, and were surrounded by other males with high centrality, in Ngogo grooming networks. We discuss these findings in the context of male social strategies.

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An analysis of limb element asymmetry in an Ancestral Puebloan population.

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The ideal course of development in most organisms is characterized by a growth trajectory resulting in bilateral symmetry; an outward, perceivable signal of viability and fitness associated with genotypic and phenotypic quality. Previous research has established that though perfect bilateral symmetry is ideal, organisms commonly exhibit bilateral asymmetry (BA). Analysis of asymmetry in long bones is an important source of information concerning the impact of nutrition, pathology, and mechanical demands on the bilateral growth trajectory.

This study proposes that BA is exacerbated by external stressors encountered by an individual. BA may result when organisms experience these insults and must allocate additional energy away from symmetric growth and maintenance in order to buffer themselves from stress exposure. We explore this relationship between BA and external stressors through the analysis of the presence of fluctuating asymmetry (FA) and directional asymmetry (DA) in the long bones of individuals of an Ancestral Puebloan population (919-1640 CE) from infancy through adulthood.

Maximum length measurements of the humeri, radii, femura, and tibiae were assessed for individuals ($n=198$) divided into five age

categories. Significant levels of BA were found in the humeri ($p=0.0003$) and tibiae ($p=0.03$). Frequency distributions reveal directional trends of asymmetry favoring the right side of both upper limb elements, with weaker trends seen for lower limb bones. Additionally, BA became more prevalent and exhibited greater percent difference as age increased. These results suggest that asymmetry in the long bones is influenced by environmental stressors that reduce an organism's ability to produce symmetric morphological traits.

Integrating $^{87}\text{Sr}/^{86}\text{Sr}$ and $\delta^{18}\text{O}$ values of archaeological enamel with geological and environmental water baseline isotopic data: a case study in geographic origins from Nasca, Peru.

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Coastal South America is an environmentally and geologically complex region. Although both strontium and oxygen isotopic studies of geographic origins and residential mobility are becoming increasingly common, data interpretation is often hampered by a limited understanding of natural isotopic variation in the study region. Here, strontium-isotope data from soil and archaeological and modern fauna, and oxygen- and hydrogen-isotope data from environmental water samples from the Nasca drainage, are used to characterize baseline isotopic variability in the region. Strontium- and oxygen-isotope analyses of enamel from twenty individuals buried at the Nasca ceremonial centre Cahuachi are then used to explore childhood place of residence. We hypothesized that enamel strontium-isotope ratios would allow identification of extra-regional childhoods, and oxygen-isotope data would enable assessment of the intra-regional place(s) of origin for individuals buried at the site. Three individuals have enamel strontium-isotope ratios outside of the local range established in this paper, which suggests that they may have spent their childhoods outside of the Nasca region. Of the seventeen individuals local to the Nasca region, eleven have oxygen-isotope compositions consistent with a place of residence in the Southern Nasca Region middle valley (i.e., in the vicinity of Cahuachi), and six individuals most likely spent their childhood in other parts of the Nasca drainage. This study demonstrates that a more informative integration of strontium and oxygen isotopic data is possible through the use of regional environmental baselines to guide the interpretation of tissue isotopic compositions.

'The other faunivory' at Semliki, Uganda: is there evidence for a 'savanna chimpanzee' pattern of insectivory?

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Chimpanzee insectivory varies widely across study sites in Africa. This includes variation in taxa consumed, tool use, and frequency of insect consumption. Analyses of prey species have shown that insects can be nutritionally important. If they are, chimpanzees in dry, open habitats, where preferred fruit species are less abundant, might show similar patterns of increased insectivory across sites. We studied the Mugiri community of the Toro-Semliki Wildlife Reserve, Uganda from May through November 2008. We measured the abundance, diversity and activity patterns of insect species known to be preyed upon by chimpanzees by doing 5 km of transects and monitoring 39 insect colonies throughout the chimpanzees' range. We also used both direct observation and fecal analysis to monitor insectivory by chimpanzees. Chimpanzees exhibited high levels of insectivory, though they consumed relatively few taxa. Of the fecal samples, 45% contained weaver ants (*Oecophylla longinoda*), 24% contained honey bees (*Apis mellifera*), 9% contained freshwater crabs, and 12% contained unknown insect larvae. We observed chimpanzees eating stingless bees (*Meloponini*) and *A. mellifera*. Mugiri chimpanzees ignored species of common and widespread termites (*Macrotermes*, *Pseudocanthotermes*, and *Trinervitermes*) and ants (*Camponotus*, *Crematogaster*, *Dorylus*, and *Pachycondyla*) that are frequently consumed by other populations of chimpanzees. We used cladistic and hierarchical cluster analyses to group long-term study sites across Africa by insect prey taxa. Neither analysis recovered a group of dry, open sites. Instead, the Mugiri community tended to cluster with other Ugandan sites. The results suggest that insectivory may depend on more than just local ecology.

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Adaptive evolution and ancestral resurrection of anthropoid estrogen receptor β .

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The actions of estrogens are mediated by estrogen receptors (ER), which bind estrogens and activate transcription of estrogen-inducible genes. Phytoestrogens, exogenous, plant-derived compounds, can competitively bind ERs and impede binding by endogenous estrogens. In primates, platyrrhines (New World monkeys) are characterized by a pattern of steroid hormone resistance, and have higher circulating estrogen concentrations than is seen in humans. Maximum likelihood analysis of multiple sequence alignments of DNA sequences collected from 20 mammal species provides evidence of positive selection in the ER β ligand binding domain (LBD) during the early evolution of the platyrrhine clade. Conversely, purifying selection acted on the gene during human descent. Hormone-induced transactivation activity was measured to test for functional consequences of sequence differences among human, spider monkey (a platyrrhine), and the resurrected ER β of the last common ancestor of extant anthropoids. Our results demonstrate that the ability of the platyrrhine ER β LBD (ateER β) to induce transcription of reporter constructs in the presence of genestein (a phytoestrogen) significantly differs ($p=0.0026$) from the binding affinity observed in the ancestral ER β LBD (ancER β). Conversely, the binding of genestein to the human ER β LBD (huER β) is not significantly different from the ancER β ($p=0.6425$). These findings demonstrate that purifying selection has maintained the function of the human ER β since the time of the last common ancestor of extant anthropoids while positive selection has altered the function of platyrrhine ER β by increasing transactivation potential. These results provide a clear demonstration of the functional effects of adaptive sequence evolution.

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Dental evidence on the origins of the Irish.

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The origins of the people of Ireland have been a topic of intense scholarly debate. The modern population of the island is thought to derive from a founding event, known historic intrusions over the last 1200 years, and a series of presumed prehistoric migrations events. Previous research by Weets (2004, 2006) illustrated a strong trend for biological continuity prior to known historic intrusions, casting into doubt large-scale migrations by Iron Age Celtic, or earlier, populations. This leaves open the question of where the prehistoric population of Ireland originated. Using the Arizona State University Dental Anthropology System, dental data were collected from 681 archaeological specimens dating from the Neolithic (c. 4000-1800 BC) to the Early Christian era (c. AD 400-1170). Morphometric traits of ancient Ireland

were compared to 14 world regional populations available in Turner and Scott (1997). One hundred single Euclidean (nearest neighbor) hierarchical clustering trees of 13 dental traits were produced, incorporating bootstrapping techniques. Forty-five of the one hundred clustering trees portrayed the closest affinity between ancient Ireland and North Africa. Forty of the one hundred clustering trees portrayed the closest affinity between Western European populations and ancient Ireland. Based on these patterns, and previous research suggesting no large-scale prehistoric intrusions, a likely origin for the population of Ireland would be Mesolithic peoples migrating from Ice Age refugia in southwestern Europe.

Human skeletal remains from Neale's Landing (46WD39), Blennerhassett Island, West Virginia.

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This study presents an analysis of the human skeletal remains from Neale's Landing (46WD39), a burial mound along a bluff on Blennerhassett Island, West Virginia, a four-mile-long island within the Ohio River. E. Thomas Hemmings of the West Virginia State Geological Survey excavated the site in 1973 and 1974 and obtained two radiocarbon dates of AD 1290 and 1520. Little information is known about the human populations from the eastern peripheries of the Ohio River Valley during this time period. The site is comprised of 27 burials with a minimum number of individuals of 42. Twenty three individuals are adult in age of which 11 were identified as male and 10 as female. Six individuals were neonates, two of which were possibly still-born twins based on their proximity in burial. Two individuals are 1-2 years-of-age; six individuals are 5-10 years-of-age; three individuals are between 10-15 years-of-age; and two individuals between 15-18 years-of-age. With the exception of one adult male with a projectile point embedded in a thoracic vertebra, there was little osteological evidence of trauma or infectious disease. Dental caries were not frequent and dental wear patterns indicate slow degeneration with age. The composition of age cohorts and few incidences of pathological conditions provide a demographic profile of a population within Ohio River Valley during the few centuries preceding and up to European contact and colonization.

How old was 'Geriatricus'? Estimating the age of old individuals with Calibrated Expert Inference.

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Over the last 250 years, the mean length of the human lifespan increased in an approximately linear fashion. However, all information has been obtained through the analysis of written sources. To gain a better understanding about the processes that shape human mortality, especially in old ages, precise information about age-at-death derived from biological remains is necessary.

Most methods of estimating age from skeletons result in open age intervals, which often start as early as 50 or 60 years of age, and lack accuracy and precision. *Calibrated Expert Inference* (CEI) solves these methodological problems by combining the knowledge about new as well as some established osteological indicators with statistical analysis to derive unbiased estimates of age at death. A single age indicator, the so-called "expert age", is processed statistically to derive an individual's age estimate. By using a non-parametric regression technique, which allows for interval-censored data, there is no need to rely on linearity between the indicator and actual age, nor on homoscedastic error distributions. A maximum-likelihood procedure is used to estimate the population mortality pattern before the individual age is calculated by applying Bayes' Theorem.

We will present the osteological indicators that are used to obtain the initial "expert age" and show the first results where CEI has been applied to populations from historical Scandinavia. These show that old ages can be identified with precision in skeletal material, and therefore it is possible to draw conclusions about the development of longevity in the past.

Spatial variation in the cranial morphology of the Portuguese.

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This study examines the relationship between craniofacial morphology and spatial variation in the Portuguese. A sample from the New Lisbon skeletal collection, an identified cemetery sample with birth dates ranging from the early 1800s to the mid 1900s was used in this study. Place of birth information was available for 322 individuals. Sixteen of the 18 administrative districts were represented in the sample. Three-dimensional cranial landmark coordinates were collected from individuals with known places of birth. Canonical variates analysis was used to examine the spatial structure by administrative district. The latitudes and longitudes for the district capitals were used in a multivariate regression analysis to examine the significance of the relationship between geography and craniometrics. Geographic and phenotypic distances were compared using a Mantel test between the Procrustes distance and geographic distance matrices. In order to control for temporal effects partial tests of both location and year of birth were examined. The results demonstrate that the craniometric data accurately reflects the spatial structure of the sample. A plot of the first two principal components demonstrates a North-South gradient to the variation. The results of the Mantel test confirm

a significant relationship between the Procrustes distance matrix and the geographic distance matrix. Portugal is a small country with no extreme environments such as high altitudes or extreme cold; therefore it seems unlikely that the spatial variation reflects environmental adaptation or natural selection. Instead the spatial variation likely reflects the unique genetic history of the country.

Calcaneal enthesophytes: etiology beyond activity.

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Calcanei are the most common sites for enthesophytes. Although calcaneal enthesophytes have been extensively researched, many unknowns remain. Whether biological factors, such as age, weight and genetics, play a greater role in enthesophyte etiology than activity is still unknown.

The current study examines 62 females and 64 males from a California Amerind population to aid in understanding enthesophyte etiology. Calcaneal enthesophytes are scored as present or absent and analyzed in regards to their relationships with sex, age, body mass and humeral robusticity. Sex and age are determined through pelvic, cranial and dental morphology. Femoral head diameters are gathered to calculate body mass using Grine and colleagues' (1995) formula. Humeral entheses scores are gathered using the method described by Hawkey and Merbs (1995) and then aggregated. Cross-sectional robusticity scores are an aggregate of areal and inertial values obtained through radiographs and calculated using formulae provided by Biknevicius and Ruff (1992). Humeri are used to reduce the probability that high robusticity is related to the same activity as those that may create calcaneal enthesophytes.

Calcaneal enthesophytes are found more frequently in older individuals (left, $t = -3.745$; right, $t = -4.819$; $P_s < 0.001$) and in individuals with higher humeral entheses scores (left, $t = -2.055$, $P < 0.05$). Marginal results include that calcaneal enthesophytes are more frequent in individuals with higher body masses (left, $t = -1.707$, $P = 0.092$). Results suggest calcaneal enthesophytes, and perhaps other enthesophytes, relate to aging, systemic bone formation and body mass, in addition to activities.

Genetic association of taste receptor pathways, caries and gender variations.

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Dental caries is influenced by the interplay of a variety of environmental and genetic factors. Dietary habits such as frequency, timing and carbohydrate source represent caries risk factors that are included in the environmental factors. Certain dietary habits can in turn be influenced by individual taste sensitivities and preferences which themselves have been shown to have a role in caries risk. Collectively, a variety of gender differences exist in different aspects of these habits and preferences. The genetic contribution of variants in the taste pathway genes to taste sensitivities and preferences has become evident. We hypothesized that genetic variation in the taste pathway genes may be associated with caries risk. Families were recruited by the Center for Oral Health Research in Appalachia (COHRA) for collection of biological samples, demographic data and clinical assessment of oral health including caries scores. Multiple single-nucleotide polymorphism (SNP) assays were performed in taste pathway genes including taste receptors and a downstream G-protein (TAS2R38, TAS1R2, GNAT3). Genotype and haplotype analysis was performed using transmission disequilibrium test (TDT) analysis (FBAT software) for three dentition groups: primary, mixed, and permanent. Statistically significant associations were seen in TAS2R38 and TAS1R2 for caries risk and/or protection. In addition to a potential role in dietary habits and taste preferences, taste pathway genes have been identified in tissues including the GI tract and pancreas with roles in hormonal responses. This presents multiple potential mechanisms for the genetic influence of the taste pathway genes on caries risk that could interplay with gender influences.

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Secular change in the femur.

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Secular changes in skeletal morphology have the potential to impact the validity of methods used to develop an accurate biological profile and interpret activity patterns. This study examines secular changes in femur morphology of modern Americans using measurements from 962 adults with birthdates ranging from the 1840s to the 1990s. Regression analysis was used to examine the correlations and partial correlations between variables.

Results indicate that the femur has increased in length, decreased in robusticity, and the midshaft diaphyseal shape has changed from relatively circular to anteroposteriorly (AP) elongated due to a decrease in the mediolateral

(ML) dimension. Femur head diameter, midshaft AP diameter, and subtrochanteric shape have not changed significantly. Nonsignificant interactions between age and the diaphyseal variables indicate that age related expansion of the diaphysis is not the cause for the observed changes.

The femur morphology of modern Americans reflects the combination of changes in stature, body build, and activity levels that have taken place over the past one and a half centuries. There is a complex relationship between the diaphysis, total femur structure, and mechanical loading, with ML dimensions of the femoral midshaft being more sensitive to the level of mechanical loading than the AP dimension in Americans. Since most methods for estimating biological characteristics from the femur are based on nineteenth century skeletal collections, it is crucial that anthropologists understand how these secular changes may affect the interpretation of sex, stature, ancestry, and activity patterns in modern Americans.

Impact of tourism on the behavior of red howler monkeys in Suriname.

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Ecotourism is commonly promoted as a potential solution to issues of primate conservation; however the impact of tourism on primate populations is generally uninvestigated. Tourists alter the environments they visit in multiple important ways, and understanding how human tourism affects primate behavior is crucial for the proper management of animals, resources, and tourists. Here I present the results of a systematic study of the impact of tourism on the behavior of wild primates at the Brownsberg Nature Park in Suriname. I tested whether monkeys living in areas with high tourist activity exhibited different behavioral profiles or different response levels to human disturbance than monkeys living outside of tourist areas. I found significant differences in both aspects of behavior between my experimental and control groups. Additionally, the monkeys have very different strategies for long-term versus short-term behavioral responses to humans depending on the degree of exposure to tourists. Sex, habituation, and startle response also influence the magnitude of monkey responses to human disturbances. These results are especially interesting in light of the energetic and reproductive needs of the monkeys, and have significant implications for future primate conservation plans.

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The influence of European contact on health and demography in the Caribbean: the case of El Chorro de Maità, Cuba.

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The Caribbean was among the first regions in the New World to experience contact between indigenous peoples and Europeans, with Columbus landing in the Bahamas, Cuba, and Hispaniola in AD1492. It is generally considered that early European-Amerindian contact resulted in the decimation of indigenous communities due to a lack of immunity to European diseases. As the indigenous use of the Cuban cemetery site of El Chorro de Maità spans the pre-Columbian and post-European contact period, the osteological analysis of the burial population allows for inferences to be made about the influence of European contact on Amerindian population paleodemography and health. The El Chorro population mortality profile appears more catastrophic than attritional in nature, with a high proportion of young adults (42.8%) and children aged 5-9 years (13.5%), and a relatively low number of mature adults (12%). The mortality profile coupled with a lack of skeletal pathology, aside from a few instances of trauma and DJD, suggests that epidemic disease may have been an influencing factor in the community. Additionally, the osteological data coupled with the analysis of the site's variable mortuary practices illustrate the dynamic interaction that occurred between Europeans and Amerindians from both a cultural and biological perspective.

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Feeding competition and stress in wild tufted capuchin monkeys: implications for the evolution of deceptive alarm calls.

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An ability to employ tactical deception against conspecifics is argued to have been a factor favoring the evolution of increased encephalization and cognition in primates. However, few systematic observations of deception in wild primates exist, and no previous study has tested whether such behaviors are underpinned by cognitive mechanisms, or can be more parsimoniously explained by non-cognitive mechanisms. Previous research has shown that wild tufted capuchins (*Cebus apella nigrinus*) use alarm calls deceptively to usurp food resources, with subordinates giving false alarms most often when food is more clumped and therefore more easily monopolized by dominants. This study tests an alternative to the cognitive hypothesis, namely that deceptive alarm calling is underpinned by the production of glucocorticoids (stress hormones). If the stress hypothesis is correct, it was predicted that competitive feeding would increase glucocorticoid production over baseline levels in subordinates more than in dominants, and that subordinates would be more stressed when food was more clumped. This was tested experimentally in Iguazú, Argentina by manipulating within-patch food distribution using feeding platforms suspended from tree

branches and filled with bananas during a period of low fruit availability. Fecal samples associated with alternating clumped and dispersed conditions were collected from 18 individuals and analyzed for concentrations of glucocorticoids using validated enzymeimmunoassay. Results from one season of experiments do not support the stress hypothesis, with neither dominance rank nor resource distribution being significant predictors of glucocorticoid concentrations. Additional research is needed to determine if the deceptive behaviors are indeed underpinned by cognitive mechanisms.

This research was supported by an NSF International Research Fellowship and a Captive Care Grant from the International Primatological Society.

Revisiting the human obstetrical dilemma: effect of pelvic rotation stride length.

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Here we focus on stride length as the major component of gait economy to explore key factors within the locomotor chain that contribute to stride length, introducing a new pelvic rotation model to compare gait performance of the obstetric/locomotor pelvis of females with the locomotor pelvis of males. We investigated anthropometrics and 3D kinematics at 1.25 ms⁻¹ and 1.75 ms⁻¹. Although females have larger pelvis relative to body mass (male 3.44±0.42, female 4.32±0.55, P<0.001) and maintained 50% larger values knee angles, they did not demonstrate different dynamic segment excursions of the lower limb from males. Although walking with absolutely shorter limbs, females match speed with males of greater limb length without differing in limb kinematics. Pelvic rotation differed by sex at both speeds (male 11.7 [5.0], 22.3 [5.2]; female 17.6 [4.3], 22.3 [5.3], P<0.002, P<0.002). Females generated greater hip translation (0.046 [0.02], 0.069 [0.02], P<0.0006) and shorter stride lengths (1.385 [0.08], 1.282 [0.08], P<0.0006). However, dimensionless stride length was greater in females at both speeds (1.46 [0.08], 1.57 [0.07], P<0.007). For their leg length, females obtained longer strides suggesting that travel distance is achieved with proportionally less limb length in females exploiting the inherent capacity of their relatively wide hips to increase leg swing with each gait cycle. Finally, our new model was a better predictor of stride length than a limb-based model, explaining 91% of the variance in males (r²=0.91, P<0.001) and 92% in females (r²=0.92, P<0.001). Comparison of the sexes showed that females experience the largest pelvic effect.

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Hanging by a limb: using non-invasive methods to evaluate ontogenetic changes in muscle mass in the limbs of a *Lagothrix lagotricha*.

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Primate infants, unlike many mammals, are not fully prepared for locomotor independence at birth. Consequently, newborn primates differ in size, shape, and body composition (i.e., muscle mass) from adults (i.e., an infant macaque hand has nearly twice the relative muscle mass of an adult). As an infant gains locomotor independence, body segments grow disproportionately in mass (i.e., the arm increases in mass, while the hand decreases). Although ontogenetic variation in body mass is well understood in quadrupedal primates, relatively little is known about the ontogeny of body composition changes in platyrrhines. Platyrrhines with prehensile tails are unique among anthropoids because these tails serve as a fifth limb capable of grasping arboreal substrates.

Here we examine the potential for using CT data to collect ontogenetic body composition data for an age and sex varied sample of *Lagothrix lagotricha* (n=11). Mimics 14.1 was used to establish contrast thresholds for individual tissues (i.e., bone, muscle, adipose, integument). Relative tissue volumes were calculated for the arm, forearm, hand and tail with respect to total tissue volume. Results are congruent with previous mass-based body composition studies employing a traditional dissection-based approach and identify ontogenetic trends similar to those observed for quadrupedal cercopithecoids (i.e., arm, forearm, and tail muscle volume increases from infant to juvenile to adult; bone exhibits minimal ontogenetic variation). This study confirms that the use of CT data is a reliable and non-invasive method for collecting body composition data and that despite locomotor differences, the ontogenetic development of *Lagothrix lagotricha* parallels quadrupedal anthropoids.

Darwin on campus: An assessment of students' knowledge of Darwin and evolution on the 200th anniversary of his birth.

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The bicentennial of Charles Darwin's birth saw a range of celebrations, symposia, and museum exhibits dedicated to his honor. In the spring of 2009, FPC developed an undergraduate, seminar-style course titled "Darwin at 200" at the University of North Dakota. Students in this course examined and discussed a range of literature placing Darwin's work in its historical and scientific contexts. Emanating from this background work, students designed and completed a group project in which

they assessed fellow students' knowledge of Darwin and his work. 200 surveys were conducted on campus. Survey questions were based on three statements thought by the class to be potentially misunderstood regarding Darwin: 1) is Darwin the source of the concept of evolution? 2) is human evolution discussed in detail in *On the Origin of Species*? and 3) is Darwin responsible for the phrase "survival of the fittest." Percentages of incorrect answers to these three questions were 65.7%, 68.1%, and 53.1%, respectively. These answers were further analyzed in relation to demographic responses, including major, year in school, state of origin, and familiarity with *On the Origin of Species*, in addition to student's confidence levels for each answer they gave. Our data, generated from a student-designed project, have yielded interesting results about students' knowledge of Darwin, but, perhaps more significantly, spark pertinent questions about teaching Darwin in the classroom, the importance of Darwin in anthropology, teaching physical anthropology, and the ramifications of such a study for students both within and outside of anthropology.

Egalitarian female relationships in *Colobus vellerosus* (ursine colobus): individualistic hierarchies with high linearity and stability, moderate bidirectionality, and low expression.

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Females that do not experience strong and consistent contest competition for food are presumed to lack decided dominance relationships. However, recent studies have documented stable dominance relationships between females that only occasionally experience contest competition. It is unclear where females in these populations lie on the egalitarian to despotic dominance continuum. It is therefore important to compare the characteristics of their dominance relationships with other populations. We investigated the linearity, expression, bidirectionality and stability of the female hierarchies in a folivorous primate, *Colobus vellerosus*. During 2004 to 2011, we collected data via *ad libitum* and focal sampling on sixty-four females in eight groups at Boabeng-Fiema, Ghana. In four groups with few unknown submissive relationships, females formed individualistic hierarchies with high linearity indices ranging from 0.9 to 1. The hierarchical expression was low based on submission rates, although there was considerable between-group variation in the latency to detect a linear hierarchy. Females in most groups formed unidirectional and stable relationships. However, maturing females challenged older females in some groups, and these groups had more bidirectional relationships and higher rates of individual rank change (ranging up to 0.83 positions per year). This between-group variation highlights the importance of using longitudinal data. Apart from higher stability, the dominance relationships were similar to those in other folivorous primates that may experience

occasional contest competition. Female *C. vellerosus* did not show as unidirectional or well-expressed submissive relationships as despotic cercopithecines. Therefore, female *C. vellerosus* lie on the egalitarian end of the dominance continuum.

Childhood milk consumption and age at menarche in NHANES: A role for IGF-I?

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The relationship between childhood diets and age at menarche has long been of interest, especially as they contribute to overall energy balance or macronutrient intake. Here I consider how a particular food, cow milk, might affect age at menarche. While the contribution of any one type of food to sexual maturation is likely to be slight, there is reason to believe that milk might be an exception. Mammalian milk is produced to support the growth and development of infants, yet among humans, consumption is both of milk from another species with a more rapid rate of growth and development and, for many, it continues well beyond the traditional age at nursing. Thus this pattern of milk consumption may influence life history parameters. Among the components of milk that might influence age at menarche, beyond calories and overall protein, is insulin-like growth factor I (IGF-I). Circulating levels of IGF-I increase with milk consumption, and IGF-I is a potent mitogen. IGF-I levels surge during pubertal development, and hence IGF-I is a candidate biomarker linking milk consumption to sexual maturation in girls. This paper uses data from the National Health and Examination Survey 1999-2004 to evaluate whether milk consumption during childhood is associated with age at menarche or the risk of early menarche after controlling for overall energy and macronutrient intake. This will allow an assessment of whether milk in the diet has some unique associations with sexual maturation in girls independent of its contribution to energy budgets, macronutrient status, or linear growth.

Population biodistance in pre-European contact central México, Veracruz, and the Yucatán.

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Migration patterns in pre-European contact México are complex, but local population affiliations might be detectable on a microevolutionary scale using dental morphological trait data, as they have been in other areas of the world. We compared four local cultural groups in adjacent regions of México to illuminate local population differences: the Toltecs and Aztec Mexicas from the Valley of México, the Totonacs from the Gulf Coast lowlands of Veracruz, and the Maya from the northern lowlands of the Yucatán Peninsula.

Samples dated to Classic and Post-Classic time periods. Pseudo-Mahalanobis D^2 distance statistics were calculated using 14 dental morphological traits in order to test three hypotheses regarding how culture group, geography, and time may have structured population relationships.

Cluster analysis and principle components of the distances show differences among the Aztec Mexica, Totonac, and Mayan/Toltec archaeological samples. Mayan and Toltec populations were difficult to distinguish from one another, a result in concordance with previously published work. Results indicate that the dental morphological trait data are sensitive enough to detect biodistance data over relatively small time and space dimensions in México, and that phenotypic similarities better reflect culture group variation than geographic or temporal variation. Seeing patterned variation in dental traits at this level is a necessary step before deepening analysis to include more sites, regions, and temporal periods. While more samples are needed, demonstrating that these groups are distinct at this broad level of analysis is heartening for future work on tracing past migration patterns in México.

This study was funded in part by Central Michigan University, Faculty Research and Creative Endeavors #48821.

Degenerative joint disease and osteoarthritis in an Etruscan skeletal sample dating from the VIIIth century to the Ist century BC.

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Middle-late period Etruscans were an Italian Iron Age community dating between 800 and 0 BC. They controlled the Mediterranean coast from Rome to Volterra and inland to Perugia, Italy. Most scholars agree that the Etruscans diverged from the earlier Villanovan community who settled this region 1100-800 BC, bringing iron technology to Italy. Paleopathological assessment of Etruscan burials, housed in the National Etruscan Museum of Tarquinia, offers insight into their health. This presentation focuses specifically on the frequency of degenerative joint disease (DJD) and vertebral osteoarthritis (OA) found among the Etruscans. This information is compared to Imperial Roman burials from Urbino, Italy. Of the 278 Etruscan specimens examined, 56 females and 86 males have at least one joint that could be assessed; while 16 females and 27 males have vertebrae available for examination. DJD and OA frequencies are compared between males and females for each joint. Sex specific patterns of DJD and OA are also explored. Results show that while both Etruscan sexes show similar frequencies of DJD and OA in most joints, males show higher frequencies of DJD in their feet and OA in their cervical vertebrae than do females. The Etruscans show lower frequencies of DJD and OA for males and females than do the Imperial Roman burials from

Urbino. Implications of these findings for interpretations of Etruscan and Italian history will be discussed.

This project was made possible in part by the 2010 Neven Lamb Scholarship and Travel Grant, Texas Tech University, Lubbock, TX.

Manual pressure distribution during stone tool use.

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Modern humans possess a highly derived thumb that is robust and long relative to the other digits, with enhanced pollical musculature compared to extant apes. Researchers hypothesize that this condition was selected in *Homo* in part to withstand high forces acting on the thumb during stone tool production. However, our previous research demonstrated that during stone tool-making the thumb in fact experienced significantly lower pressures and normal forces compared with other regions of the hand. In this paper, we test an alternative hypothesis that stone tool use may have distinct pressure distribution patterns that place greater stress on the thumb.

We used a dynamic pressure sensor system to measure pressures and normal forces acting across the hand during a variety of stone tool behaviors hypothesized to have been practiced by early hominins. Tested behaviors included slicing animal muscle using a flake and a handaxe, acquiring marrow using a hammerstone and a chopper, and nut-cracking. Subjects included experienced and novice knappers.

Contrary to stone tool production, stone tool use placed similarly high or significantly greater pressures and/or normal forces on the thumb compared with digits II-III. During nut-cracking, pressures and normal forces tended to be lowest, but differences between the thumb and digits II-III also tended to be strongest.

These results suggest that stone tool use, rather than production, may have been a stronger selective pressure on pollical robusticity. They also raise questions about why pollical robusticity appears so late after the earliest records of stone tool use.

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Resampling analysis of craniofacial sexual dimorphism in *Australopithecus africanus* and *A. robustus*.

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The sexual dimorphism of *Australopithecus* has been investigated previously using resampling methods. These have provided measures of sexual dimorphism relative to extant hominoids. However, craniofacial measures have rarely been subjected to resampling methods to provide a measure of dimorphism, partially due to the fragmental nature of the fossils. Here we compare the craniofacial sexual dimorphism of *Australopithecus africanus* (n = 22) and *Australopithecus robustus* (n = 9) to *Pan paniscus* (n = 45), *Pan troglodytes* (n = 44) and *Homo sapiens* (n = 91). Because of the lack of completeness of fossil specimens, we focus on compatible subsets. In previous resampling tests of the postcranium, males regularly exceed females, yielding dimorphism measures greater than one. However, in the craniofacial region, this pattern may not always hold. Therefore, an absolute measure of dimorphism was included to avoid the loss of information when calculating geometric mean values. *Australopithecus robustus* exhibits the greatest geometric mean of dimorphism measures among the taxa examined. For extant taxa, the average of geometric means for *Pan troglodytes* exceeds *Pan paniscus*, and both are higher than those for *Homo sapiens*. However, the standard deviation for *Pan troglodytes* is pronounced; the geometric mean of absolute dimorphism measures for *Australopithecus robustus* falls within one standard deviation of *Pan troglodytes*. *Pan paniscus* exhibits a narrow range of values for the geometric mean of absolute dimorphism measures. *Australopithecus africanus* exhibits an average of geometric means between those obtained for the two species of *Pan*.

This study was supported by the Fulbright Foundation, the Belgian American Educational Foundation and the Vice President for Research at Georgia State University.

Osteoperiostitis sex differences in southern German medieval and postmedieval populations.

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In a wide range of settings, adult females display higher prevalence of osteoperiostitis than adult males, suggesting sex differences in the immune system. This study tests the hypothesis that females show lower frequencies of infectious disease when compared to males by examining the frequency and severity of osteoperiostitis in the tibia. Skeletal samples from five southern German sites were used, deriving from the medieval (ca. AD 900-1200) and postmedieval (ca. AD 1200-1800) periods. Tibiae were assessed for completeness and only bones with over 70% observable periosteal surface were included. Sex and level of osteoperiostitis were scored using methods listed in the Global History of Health Project codebook, available online. This research focuses on those tibiae with an osteoperiostitis score between four and six, where four indicates

moderate modification of up to one-quarter of the periosteal surface, five indicates moderate to severe modification of over half the diaphysis, and six indicates osteomyelitis. Both right and left tibiae were examined and individual scores were assigned based on the highest score estimated for either bone.

Over one-quarter (n = 101) of the total sample could be assigned a sex and had at least one tibia complete enough to score. This resulted in 58 females and 43 males. 15.5% of females and 27.9% of males showed an osteoperiostitis score between four and six ($\chi^2 = 2.302$, p = 0.129). These findings are consistent with a range of other settings showing clear female/male differences in skeletal infection as it pertains to the lower limb.

This research was funded by the Deutscher Akademischer Austausch Dienst, The Ohio State University Alumni Grant for Graduate Research, and Sigma Xi (the Scientific Research Society).

Variation in hominoid vertebral formulae: implications for the evolution of the hominin vertebral column.

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Within- and between-species variation in vertebral formulae has complicated our understanding of hominin vertebral evolution. This study quantifies variation using diversity and similarity indices, which measure intraspecific and interspecific variation, respectively. These indices allow for testing the "short-backed" and "long-backed" models of hominin vertebral evolution, which call for disparate amounts of homoplasy, and by inference, different patterns of evolution. Under the long-back scenario, reduced variation (low diversity) in vertebral formulae is expected, resulting from relatively strong directional selection that is presumably associated with extreme homoplasy (independently and repeatedly reduced lumbar regions), particularly in closely related species that diverged relatively recently (e.g., chimpanzees and bonobos). Instead, high amounts of intraspecific variation are observed among all hominoids except humans and eastern gorillas, species that have likely experienced strong stabilizing selection on vertebral formulae associated with locomotor (i.e., bipedalism) and habitat specializations (i.e., terrestriality), respectively, or resulting from recent population bottlenecks. Interspecific variation is structured in such a way that vertebral formulae observed in western gorillas and chimpanzees represent a reasonable approximation of the ancestral condition for hominines, from which eastern gorillas, humans, and bonobos derived their unique vertebral profiles. Overall, these results support the short-back model and are consistent with a scenario of homology of reduced lumbar regions in hominoid primates. Therefore, hominins evolved five lumbar vertebrae from an "African ape-like" ancestor with a short (4-element) lumbar column via homeotic (border shifting), rather than meristic (numerical), change. Fossil hominin vertebral columns, including those of recently

discovered *Australopithecus sediba*, support this model.

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The Neolithic demographic transition (NDT) and patterns in oral health: the Southeast Asian experience.

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The transition to food producing economies in mainland Southeast Asia occurred sometime between 4,500-4,000 BP with the best cemetery evidence for Neolithic communities occurring shortly after this in Thailand (e.g., Khok Phanom Di) and Vietnam (e.g., An Son and Man Bac). Until recently Southeast Asian dental assemblages have been generally characterised as displaying low levels of caries and good oral health (see contributions by Oxenham and Tayles in particular). This paper questions this assertion for the earliest and best documented Neolithic sites in the region (e.g., caries rates by tooth count exceed 10% at all of these early sites). Poor levels of oral health ostensibly occur in the context of three enormously significant events: major demographic change (e.g., 15P5 values in excess of 0.25 indicating elevated fertility), changes in subsistence economies (earliest evidence for agriculture) and increases in mobility (e.g., large scale migration into the region). It is concluded, in contrast to the currently held consensus, that Southeast Asia displays a similar oral response to the initial emergence of the Neolithic seen in other regions of the globe.

Farming, food and fitness in highland Ethiopia: anthropometric and dental indicators.

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We conducted surveys, anthropometric assessments, and dental examinations in two drought-prone regions of Ethiopia from June through August of 2011. Both regions are known for high vulnerability to food insecurity. Our sample included individuals within 150 households of South Wollo, an area located within the Amhara region of north central Ethiopia and the 'buckle' of Ethiopia's famine belt. Additionally we assessed 202 households in East Harrage, an area of the Oromia region in Eastern Ethiopia.

Health and nutrition indicators, including weight-for-height, the ratio of arm span-to-height, mid-arm circumference, and the number of missing and decayed teeth, varied significantly among villages at different altitudes. Preliminary analyses indicate that in South Wollo, villages at the highest altitude exhibited the greatest degree of malnutrition, followed by lower altitude villages. Villages at mid-altitude contained the largest number of households with the least malnourished individuals. One factor which varies within South Wollo is the amount of time land has been cultivated; some of the households at the highest altitudes were only established in the last three decades. By contrast, in East Harrage, where cash-crops predominate, micronutrient deficiencies are prevalent despite resource availability.

For both regions, there are other factors at work which affect nutrition and health status. Among these are access to water for irrigation, access to treated drinking water, livestock available for food and work, household assets, availability of health care, and cash and food crop production. Nutritional and dental education is needed to mitigate health decline among households in both regions.

We thank the University of Nebraska Institute for Agriculture and Natural Resources' 'Integrated Seed Grant Program' for providing resources to conduct this research.

Predictors of death: a life-history approach for understanding oral health patterns during the late prehistoric period in the Eastern Woodlands.

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Bioarchaeological research on the relationship between oral health and sex challenges scholars to think dynamically about lesions on teeth and supporting bone as indicators of morbidity and mortality that are simultaneously influenced by population dynamics (e.g., fertility rates). Given the inability to observe skeletons at any time except death, oral health pathologies are measured in the present study as covariates and predictors of mortality through survival analysis. Previous research by the author has demonstrated a strong association between carious lesions on molars and mortality among reproductive-age females from the late prehistoric period in west-central Illinois. The present study utilizes a life-history approach and the theoretical insights synthesized in the "Osteological Paradox" (Wood et al. 1992) to expand upon this research and examine sex-specific oral health patterns in the Eastern Woodlands of North America during the 1,000 years prior to European contact.

Sex-specific patterns of carious lesions, abscesses and ante-mortem tooth loss are analyzed across time and space utilizing Cox proportional hazard models. The hazard rate associated with poor oral health is shown to be significantly higher among reproductive-age females during the Mississippian period in west-central Illinois and the lower Ohio River valley. Young adult females in these high-fertility agricultural societies experienced a differential

risk of death when compared to their male counterparts. A subsequent meta-analysis of published data from the Eastern Woodlands reveals that re-examination of extant skeletal samples with appropriate analytical methods has the potential to support and expand upon the present findings.

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Rates of lethal aggression in chimpanzees depend on the number of adult males rather than measures of human disturbance.

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Wild chimpanzees sometimes kill other chimpanzees. Why they do so has been controversial. Here we use a species-wide dataset to ask to what extent such killings (a) occur in the species as a whole, (b) result from human disturbances, such as deforestation, hunting, or food-provisioning, and (c) occur frequently enough to affect behavior. Including only cases in which the attack was observed, the body was found, or observers found other compelling circumstantial evidence, data from 17 habituated communities at 10 sites revealed 77 cases of killings by chimpanzees. Most killings (78%) were conducted by groups of males, and most victims (82%) were also male. More victims were infants (57%) than adults (35%); juveniles and adolescents were rarely targeted. Most killings (68%) involved intergroup attacks. The number of killings recorded per site was related to the number of males in a community, but not to measures of human disturbance. Expressed in terms used for homicide rates, males killed other grown males at a median rate of 4,658 per annum per million individuals. In contrast to

chimpanzees, no lethal conspecific aggression has been documented among wild bonobos (N = 4 communities at 3 sites). We conclude that lethal aggression is a species typical behavior of chimpanzees that occurs sufficiently often to affect the evolution of chimpanzee behavior.

This study was funded by National Science Foundation grant BCS-0648481. Numerous additional sources of funding have supported the long-term studies that contributed data to this study.

The social structuring of stress in contact-era Spanish Florida: a bioarchaeological case study from Santa Catalina de Guale, St. Catherines Island, Georgia.

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Skeletal biology offers a potential wealth of information about human social behavior, especially in regard to inequality and how differences in access to food and other resources are expressed in stress and wellbeing in past societies. This paper explores the relationship between stress and social status at Mission Santa Catalina de Guale (n = 421), a key mission outpost located on St. Catherines Island, Georgia (ca. A.D. 1600-1680). We test the hypothesis that relative position of skeletal remains located closest to the ritual nucleus of the church (the altar) reflects higher social position in the community, and hence, greater access to resources and better living circumstances. To test this hypothesis, we undertook GIS-based analysis of location of dental caries and linear enamel hypoplasias as indicators of dietary quality, nutritional inference, and generalized stress. Status rank was identified on the basis of elaborateness of grave inclusions (e.g., presence of glass beads) and burial treatment (e.g., inclusion in coffin). There was no association between hypoplasia and location of grave or burial treatment (Fisher's Exact test, p>0.05). However, individuals interred closest to the altar were less carious than individuals interred furthest from the altar (χ^2 , p<0.05). This study suggests that individuals buried closer to the altar had a higher-quality diet and greater access to resources than those buried further from the altar. These results strongly suggest clear social distinctions in health and wellbeing in this colonial setting of North America.

This study was supported by the U.S. National Science Foundation and The Ohio State University.

Species differences in the ontogeny of testosterone production between chimpanzees and bonobos.

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Patterns of skeletal, behavioral, and cognitive development have been found to differ between humans' two closest living relatives, chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*). In particular, aspects of mating behavior and male aggression have changed significantly between the two species, suggesting a potential link between the production of testosterone and these shifts in developmental trajectories. Here we tested this hypothesis by measuring the ontogeny of testosterone production in chimpanzees and bonobos ranging from infancy to adulthood, utilizing a method of salivary steroid analysis validated by previous work. We also collected data on body weight in the two species across the same age range to provide a general growth index. We found that among chimpanzees, juvenile testosterone levels were low and both sexes showed markedly increased testosterone production during adolescence (males more so than females). In contrast, among bonobos, testosterone levels remained consistent throughout infancy, juvenility, and the transition to adulthood. The stability of testosterone production during bonobo development was not associated with stunted growth in our study population; data on body weight revealed that chimpanzees and bonobos showed broadly similar patterns of growth, with chimpanzees larger at every age. These results suggest that if elevations in testosterone occur during puberty in bonobos, they are short-lived. They also indicate that the ontogenetic pattern of testosterone production can be subject to rapid evolutionary change. In the case of bonobos and chimpanzees, changes in the developmental trajectories of testosterone production may provide one mechanism underlying broader developmental differences between the two species.

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An analysis of the relationship between degenerative joint disease and enthesopathies in Korea's Joseon dynasty population.

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The aim of this research is to examine the relationship between degenerative joint disease (DJD) and enthesopathies while taking different peripheral joints, types of entheses (i.e., fibrous, fibrocartilaginous), and the criteria of DJD diagnosis into account. We hypothesize that the association between DJD and enthesopathies would be differentially represented along the characteristics of joints and the types of entheses, and the diagnostic criteria of DJD (i.e., lipping or osteophytes, pitting or porosity, and eburnation). In this research, 170 individuals from Eunpyeong Cemetery (Seoul, Korea, mid 15th-early 20th centuries) were analyzed. The occurrences of DJD and enthesopathies at 6 peripheral joints—shoulder, elbow, wrist, hip, knee, and ankle—were compared by Fisher's exact test in which age and sex were controlled.

The results revealed that there is a significant association between DJD and enthesopathies regardless of the characteristics of joints and types of entheses. The DJD scores were positively correlated with the enthesopathies scores as they had been in previous studies. As to the criteria for DJD, osteophytes and eburnation were correlated with the enthesopathies scores more than porosity. The results suggest that when DJD is used in conjunction with enthesopathies, it would be possible to show more reliable evidences for actual life conditions than when only one indicator is used. As to the criteria for DJD, porosity might not be an unrelated criterion.

This study was funded by the Seoul National University, Brain Fusion Program Research Grant (2010).

It is better to receive than to give: costs and benefits of social grooming in vervet monkeys (*Chlorocebus aethiops*).

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This study examines associations between social grooming and parasitic infection in wild vervet monkeys (*Chlorocebus aethiops*) in Loskop Valley, South Africa. Social grooming has been viewed as a behavioral strategy to help hosts rid themselves of parasites (i.e., the hygiene hypothesis). Social contact has been shown to be beneficial to the immune system, however the close contact involved in social grooming may increase parasite transmission. We tested the null hypotheses that there were no differences in proportion of time spent grooming with others and number of grooming partners between groups infected with various gastrointestinal parasites. Focal animal sampling and continuous recording were conducted, and fecal samples were analyzed for gastrointestinal parasites, using fecal flotation, fecal sedimentation, and immunofluorescence microscopy. Individuals infected with *Necator* sp. had a significantly greater number of grooming partners ($F_{1,36} = 13.18, P < 0.001$) and spent significantly more time grooming others ($F_{1,36} = 4.22, P < 0.05$) than those not infected. Individuals infected with *Entamoeba* sp. spent significantly less time receiving grooming from others than those not infected ($F_{1,36} = 10.14, P < 0.004$). Close contact involved in social grooming may increase infection with potentially pathogenic parasites, as individuals may ingest infective stages of parasites removed from grooming partners. Individuals who receive less grooming may exhibit increased parasitic infection, through parasites not being groomed off the body, or through reduced immune function from lack of physical contact with others. Thus, the relationship between social grooming and parasites is more complex than the hygiene hypothesis acknowledges.

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Foundation, and Purdue University Dept. of Anthropology.

In silico comparisons of craniofacial biomechanics in platyrrhine and strepsirrhine destructive and extractive foragers to determine the diet and ingestive behavior of the subfossil *Archaeolemur*.

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Recent stable carbon isotope and finite element analyses of the craniofacial biomechanics of the subfossil lemurs *Hadropithecus* and *Archaeolemur* have revealed differences suggestive of tough food feeding in *Hadropithecus* and a broader diet including some large hard foods in *Archaeolemur*. In this study we further investigate the feeding propensities of *Archaeolemur* by comparing its craniofacial biomechanics with that of the destructive feeding *Sapajus apella* and sclerocarpic *Cacajao calvus*. Finite element models of all species were created from CT scans of the crania of single individuals. Five different bite point load cases were compared, including biting at the upper incisors, upper canine, P³, and M². The fifth case involved a *Cacajao* specific pattern of loading with constraints on the buccal edge of the lateral incisor and lingual edge of the canine loaded to mimic the exploitation of pyxidia of the family Lecythidaceae. In every bite case *Cacajao* exceeded both *S. apella* and *Archaeolemur* in biting efficiency (muscle force/bite force). In turn, *Sapajus* exceeded *Archaeolemur* in every case and more closely approximated *Cacajao* in efficiency. Maps of von Mises stress also revealed a markedly more diffuse pattern of stress for all load cases in *Archaeolemur*, which is hypothesized to be a consequence of the open post-orbit. The fact that *Archaeolemur* more closely approximates *Sapajus* in bite efficiency suggests a relatively generalized form of destructive and hard food feeding in this subfossil lemur. These findings are further discussed in light of preliminary observations of the craniofacial biomechanics of the wood gouging *Daubentonia madagascariensis*.

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Determination of sex from differences in tooth size in a modern admixed population from New Mexico: relative efficacy of permanent and deciduous teeth.

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There has been a long tradition of using permanent tooth size for the determination of sex of unknown individuals. Few studies have

attempted to employ measurements of the deciduous teeth for these purposes with success. Moreover, it is imperative that previous research and formulae that have been employed in the past for forensic identification continue to be tested among different genetic ancestries. This research compares the relative success of measurements of the deciduous and permanent teeth for estimation of sex among 400 identified admixed individuals of modern Hispanic ancestry living in the greater Albuquerque metropolitan area.

Maximum mesiodistal lengths and buccolingual breadths were measured for all undamaged left side teeth. Discriminant function analysis was used to calculate power formulae for separation of males and females for deciduous and permanent teeth, respectively. Power formulae with the highest discriminatory power in separating males from females were retained for all teeth considered.

Results indicate that measurements obtained from the permanent dentition yield markedly higher correct identifications for sex determination than yielded by the deciduous teeth. However, once males are distinguished from females, deciduous teeth yield equally high rates of correct identification.

Morphological diversity among tufted capuchins.

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Capuchin monkeys (genus *Cebus*; Erxleben, 1777) present a compelling model taxon for studies of primate morphological and behavioral adaptation and evolution, particularly given that the genus is host to two distinct morphotypes: a robust tufted group and a gracile untufted group. In the past, the tufted morphotype has essentially been treated as an undifferentiated species and the morphology, behavior, and ecology of a single subspecies has been used to illustrate the tufted ecomorphological pattern. With this history in mind, we ask a central question: How well is our present understanding of tufted capuchin species diversity reflected in both their craniofacial and postcranial morphology? To address this, we use multivariate and phylogenetically generalized bivariate analyses of cranial and postcranial features among tufted capuchin species to test how adequately these taxa can be assigned to their proposed species and how well these morphologies relate to what we know of their diet and positional behavior. Our results suggest that there are four distinct morphological groups consisting of two species in northern South America, two in northeast Brazil, three in central and eastern Brazil, and one in the south west of Brazil into Paraguay. We suggest that microevolutionary differences among these groups can be explained by particular selective pressures present in the ecozones inhabited by

these groups. We argue for a collaborative effort to clarify the ecology and evolutionary history of this diverse and adaptable taxon.

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Brain morphology of Zhoukoudian *H. erectus*.

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Endocasts of six of the Zhoukoudian *H. erectus* crania, deriving from Locality 1 with a geological age of ~0.5 mya, have been reconstructed. New CT and 3D modeling of these endocasts make detailed and accurate comparisons possible. The average volume of the endocasts is 1058 ml, which places them in the middle of the range of endocranial volumes obtained for a broad spectrum of *H. erectus* ranging from 600 to 1251 ml. The ZKD brains have several features (low height and low position of the greatest breadth, flat frontal and parietal lobes, depressed Sylvian areas, strong posterior projection of the occipital lobes, anterior positioning of the cerebellar lobes relative to the occipital lobes, and relative simplicity of the meningeal vessels) that distinguish them from modern Chinese. Compared with the other ZKD endocasts, ZKD 5 (with the highest stratigraphic position) has a few 'progressive' features foreshadowing modern *Homo sapiens* brain morphology including bossed parietal lobes, wider frontal lobes, and greater total volume. The shared features of the ZKD and other comparative *H. erectus* endocasts suggest that this aspect of the morphology, more than any other feature, which can be regarded as the definitive characteristic of presapiens members of the genus *Homo*.

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Variation in plantar pressure distribution in habitually unshod humans.

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Fossil footprints provide a unique record of locomotor behavior in extinct species, yet the interpretation of fossil footprints requires a clear understanding of foot biomechanics in modern analogs. The recent discovery of 1.5 million-year-old hominin footprints near Ileret, Kenya has highlighted the importance and the paucity of quantitative pedal biomechanics data on humans

whose feet have not been influenced by modern footwear. Human foot shape differs across ethnic groups, yet only one study has quantified plantar pressure distribution in habitually unshod humans (D'Août 2009, *Footwear Science*, on unshod Indians). We examined plantar pressure distribution in two African populations, both unshod-minimally shod, in order to assess natural variation in human foot function and to develop a more inclusive model of human foot function that can be used to interpret fossil footprints and skeletal material.

Fifty adults from Ileret, Kenya and from Mahajoroarivo, Madagascar walked barefoot across a plantar pressure mat at a self-selected pace. Video was collected for kinematic analysis, and steps were compared within a restricted speed range. Peak pressures follow general trends observed in other unshod samples such as lower overall peak values, however some differences (e.g., lack of reduced heel pressures) were observed. Both groups exhibited similarly low medial and central metatarsal head and toe peak pressures compared to shod humans. Lateral forefoot peak pressures were higher in the Kenyan group. Understanding the nature and variation of foot function among unshod populations is necessary to make reliable inferences about locomotor function in hominin fossils and footprints.

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Human health and hydrocarbon exposure along the prehistoric West Coast.

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Physical anthropological research on prehistoric human populations of the Santa Barbara Channel Islands of California has documented an overall health decline over many thousands of years, indicated by extensive skeletal evidence of increases in stress and disease. Although this decline may be partly related to factors of climatic instability, population growth, and ecological change, we have recently suggested that increased exposure to toxic polycyclic aromatic hydrocarbons (PAHs) may have been an additional factor. Concurrent with decreasing trends in stature and head size - documented health effects of fetal PAH exposure - we have previously found evidence of an increasing trend in cultural usage of PAH-rich bitumen from natural petroleum seeps in the area. To estimate the amount of PAH exposure and bioaccumulation experienced by local populations, we here used gas-chromatography/mass-spectrometry (GC/MS) to measure PAH contents in organic material from the Channel Islands and in raw bitumen from natural seeps. To investigate the potential levels of PAH exposure through drinking water, we measured PAH contents in water stored in

modern replicas of bitumen-lined water-bottles, which were used in the Santa Barbara Channel region from the Middle to Late Holocene. The results allowed us to assess the potential significance of different PAHs pathways and quantify levels of exposure for the human populations in the region, to add time depth to studies of potential PAH exposures caused by traditional cultural practices in modern tribal communities, and to illustrate the need for further investigations of environmental chemical toxicity in the ancient world.

Wet season dietary comparisons of *Lemur catta* populations in southwestern Madagascar.

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The diets of ring-tailed lemurs (*Lemur catta*) in the gallery forests of southern Madagascar are dominated by the fruits of *Tamarindus indica* (kily). Our earlier work has associated the heavy postcanine wear observed in populations at Beza Mahafaly special reserve (BMSR) with their reliance on kily fruit, which is the most frequently eaten food in their diets and the most mechanically challenging. In the present study, we extend comparisons of *L. catta* diets to sites that differ in the degree to which kily is present. The gallery and dry/spiny forests of BMSR and the dry forest and scrub of Tsimanampetsotse National Park (TNP) range from kily-dominated in BMSR to moderately populated in TNP.

We conducted feeding observations and tested food properties (toughness, modulus, hardness) of *L. catta* populations at the two locations in successive rainy seasons in 2010 and 2011. The *L. catta* population at TNP did not eat kily fruit during the observation period, though they do later in the year. Kily fruit shell was the toughest plant part tested across sites, and the BMSR diet was tougher overall. However, some succulents and fruits in the TNP diet were also quite tough, and the mechanical profiles for the two sites looked similar. Hardness and modulus values were more varied and overlapped. Earlier work showed that the TNP lemurs had less dental wear and loss than the BMSR populations. Our findings support the idea that the physical properties and degree of consumption of kily fruit are responsible for increased dental wear.

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Developing STR loci for snub-nosed monkeys (*Rhinopithecus roxellana*) using next-generation sequencing technology.

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Simple tandem repeats (STRs) are widely used to estimate genetic variation, population structure, and relatedness in wild species. However, developing STR systems are time consuming, especially for species where little is known about its genome. In this study, we describe a protocol of generating a large number of candidate STR loci quickly and cost-efficiently for a non-model species, snub-nosed monkeys using next-generation sequencing technology. First, we built a reduced representation library for snub-nosed monkeys. We digested the DNA of four individuals using *HaeIII* and pooled the 350-500bp fragments together. Second, we sequenced the DNA pool using pyrosequencing technology. We obtained 275,618 reads (330bp per read) from a single run of ¼ region of a titanium plate. Third, we used the program Msatcommander to detect STRs in the sequence dataset. This program reports the name of the sequence read, repeat type, repeat number, as well as the start and end positions of the repeat region. Using a script written for this study, we examined the output file reported by Msatcommander and detected 10 polymorphic STR loci. Furthermore, based on the assumption that STR loci with long repeats (> 9) are likely to be polymorphic, we detected 347 candidate STR loci, which are distributed across all autosomes and X chromosome. We validated two candidate loci by genotyping these two loci in 20 individuals. The confirmed polymorphic STRs can be put to use immediately and the large number of candidate loci can be easily screened for polymorphism and linkage for future use.

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Metagenomic comparisons of gastrointestinal microbial function in hominoids.

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Dietary shifts are central to human evolution. Bacterial metabolic processes conducted by gut microbes may contribute to dietary adaptations, especially through digestion of resistant fiber. However, the contributions and significance of bacterial metabolic processes to human diet remain poorly understood.

We investigate bacterial metabolic contributions to diet analyzing fecal samples from 13 individuals, including wild gorillas (*Gorilla gorilla*) and free-ranging chimpanzees (*Pan troglodytes*), comparing these to published data from humans and captive gorillas and chimpanzees. We used high-throughput sequencing, attaining significant sequencing

depth (>100 million reads), to describe microbial community structure and to identify functional genes in microbial samples. These data enable comparisons of microbial metabolic comparisons.

Substantial microbial differences characterize gorillas, chimpanzees, humans, and captive animals, revealing contrasts in both the structure and function of microbial ecosystems among groups. Protein metabolism prevailed in wild apes. Wild gorillas also harbored more microbial genes dedicated to polysaccharide and RNA metabolisms, while free-ranging chimpanzees were enriched for aromatic compounds, iron, virulence potential, and secondary metabolisms. Humans and captive apes were significantly enriched for central carbohydrate, fatty acid, and lipid metabolism genes. Humans were also enriched for sulfur metabolism.

Distinctions among microbial genomes may contribute to the evolution of host dietary differences. Microbial involvement in protein metabolism in noncaptive samples may be especially relevant to diet. We discuss computational challenges posed by metagenomic data, and consider the evolutionary significance of microbial community differences among host species.

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Decreased maintenance energy expenditure in modern humans and the resultant demographic displacement of archaic humans.

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Energy investment in reproduction is of primary evolutionary importance, and changes in energy budgets due to shifts in anatomy, activity, or development can affect reproductive rates. The energetic consequences of differences between archaic and modern humans can therefore provide insight into how modern humans were ultimately able to outcompete their archaic counterparts. Here we investigate three major areas of differentiation between archaic and modern humans that likely had significant energetic ramifications, and for which reliable fossil evidence exists: body size, locomotor anatomy, and juvenile growth. Using these data, we explore potential energetic disparities between archaic and modern humans in terms of proportions of energy budgets of reproductively active adults dedicated to maintenance (basic life functions and physical activity) vs. offspring production. In comparison to modern humans, adult archaic humans would have had higher maintenance costs corresponding to their larger bodies (higher resting and activity energy requirements) and shorter lower limbs (reduced locomotor efficiency). Moreover, faster growth rates in archaic juveniles would have meant slightly higher daily energy requirements for dependent offspring in archaic vs. modern humans. Overall, assuming similar caloric

returns from foraging in both groups, modern humans' smaller bodies, longer lower limbs, and slower development may have allowed them to produce a greater number of viable offspring over the reproductive lifespan than could archaic humans, possibly at a ratio of ~6:5. These reproductive differences may have facilitated higher population densities among modern humans, likely contributing to the rise of modern humans and disappearance of archaic forms.

Education and marital status are protective against active tuberculosis in Monterrey, Mexico.

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The Monterrey Metropolitan Area (MMA) has almost double the rate of pulmonary tuberculosis (TB) compared to the Mexican national average, despite high wealth, education, employment, and living conditions. Given this unique setting, we explored predictors of active TB through a multilevel approach of individual, household, and social measures. A case-control study was performed during January-July 2010 at the University Hospital "Jose Gonzalez" in Monterrey, Mexico. Cases (n=97) had laboratory confirmation of active pulmonary TB and controls (n=40) had skin test confirmation of latent TB infection. Socio-demographic, health, housing, and lifestyle variables were collected through in-depth interviews and medical records. Mean participant age was 43.8 years (\pm 15.9), and 56.9% of the sample was male. Most participants were non-indigenous (79.6%), non-professional or never employed (67.9%), and low to middle socioeconomic status (71.6%). Unadjusted analysis showed that active TB was significantly associated with marital status, education, and principal lifetime employment. Adjusting for all potential risk factors using backward selection multivariable logistic regression, we found a protective effect of education (OR 0.59, 95% CI 0.40, 0.88) and marital status (OR 0.36, 95% CI 0.16, 0.81) against active TB. The results indicate that education is an important determinant of health, even in a relatively wealthy region. Consistent with other studies, spousal support is recognized for its association with health, independent of socioeconomic factors. Its protective effect has been related to psychological health, healthcare access, and latent TB treatment completion. This research highlights multilevel factors of active TB risk with implications for prevention in Mexico.

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Institute, Office of Graduate Studies, and the Institute of Public Health.

Evolutionary implications of quadrupedal locomotor mechanics in cotton-top tamarins (*Saguinus oedipus*).

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Decades of experimental research have identified several relatively unique mechanical features of primate quadrupedalism, chief among them the habitual use of diagonal sequence (DS) gaits and hindlimb dominance in body weight support. Consensus states that such features facilitate stability on narrow and compliant arboreal substrates. The association between these locomotor features and fine-branch arboreality has been bolstered by evidence that marmosets (*Callithrix jacchus*) – gummivores specialized for locomotion on broad tree-trunks – are unusual among primates, and more similar to other mammals, in showing a preference for lateral sequence gaits and forelimb dominated weight support. In this study, we further tested the links between primate quadrupedal mechanics and fine-branch arboreality by investigating the locomotion of cotton-top tamarins (*Saguinus oedipus*), callitrichine primates that frequently travel and forage on narrow branches, despite being morphologically quite similar to marmosets. We recorded biomechanical data from three *S. oedipus* (mass: 485-546 grams) moving over a horizontal 3.2cm diameter pole, examining a total of 57 walking and 110 running strides. DS gaits predominated, representing 61% and 88% of walking and running strides, respectively. Nevertheless, tamarins were primarily forelimb dominant in body weight support. Within strides, peak vertical forelimb forces exceeded peak vertical hindlimb forces by an average of 16% (peak force ratios: 0.72-1.98), and impulse ratios indicated that tamarins supported 52% of body weight on their forelimbs (range: 42-63%). Overall, these data suggest that fine-branch arboreality may be necessary, but not sufficient, to select for the suite unusual locomotor features common to most quadrupedal primates.

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Making faces: genes, development, and the evolution of human cranial shape.

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Hominins exhibit significant evolutionary variation in facial shape and size, yet the genetic

and developmental mechanisms involved in these interspecific differences remain poorly understood. For example, we know relatively few genes involved in human facial morphogenesis, what functional roles they may play during growth and development, and how heritable variation in their expression might contribute to the continuous phenotypes that selection acts upon. To better address these questions, we have initiated a project called "FaceSpace," with the goals of characterizing normal human facial variation, identifying gene candidates involved in shape and growth, and testing their developmental contribution to variation via experimental analysis in model systems. We use as an example our analysis of the Sonic hedgehog (SHH) cell-signaling pathway, which has been implicated in both human facial birth defects and vertebrate brain and face evolution. We demonstrate that when experimentally modulated in the brain, variation in SHH-signaling activity contributes to integrated changes in vertebrate facial breadth that are relevant to human cranial evolution. Our results show how normal and abnormal human facial variation can be used to generate experimentally tractable hypotheses, and more importantly, how traditional anthropological strengths in quantitative morphometric analysis of variation can be combined with developmental biology to yield significant human evolutionary insights.

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Sagittal suture complexity and its relationship to cranial shape and cranial vault thickness.

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Research suggests that increased suture complexity results from increased mechanical loading of the cranium. In addition to the role of loads created by masticatory musculature, postural muscles and other sources, the exact cause of the increased complexity requires further analysis. Most studies only examine muscle or molecular activity, but fail to examine structural features of the neurocranium that may affect suture complexity. For example, the neurocranium is best modeled as a shell in which morphology can be related to an array of biomechanical variables. Thus, changes in head shape should result in predictable morphological changes, such as suture complexity. This study investigates the relationship between sagittal suture complexity, head shape, and vault thickness. The sagittal suture was traced and digitized using a temporally and geographically heterogeneous sample of crania (n = 29). Sagittal suture complexity was estimated by calculating relative suture length (RL) along the entire suture (total RL). Additionally, the suture was divided into thirds and RL calculated for each segment. Standard linear osteometric measurements are used to calculate four indices reflecting head shape. Mean vault thickness was calculated from 17 landmarks.

No statistically significant relationships were found between total RL and the

morphometric variables examined for this sample, although there is some indication of an association between cranial breadth and total RL. In addition, there are differences in RL along the sagittal suture segments. It is hypothesized that the pattern differences along the sagittal suture are due to the interplay between the temporalis muscle insertion and cranial breath.

Does the delivery mode influence enamel neonatal line thickness variation?

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The transition from an intra- to extra-uterine environment leaves its mark in deciduous teeth (and first permanent molars) as an accentuated enamel incremental ring called the neonatal line (NL). This prominent microfeature separates the enamel formed during intrauterine life from that formed after leaving the womb. However, while the physical structure of this scar is well known, the bases of its formation are still a matter of investigation. In particular, besides the influence of the birth-related abrupt environmental and dietary changes and the role played by physiological factors such as hypocalcaemia, it has been suggested a direct relationship between NL thickness variation and the physical trauma implied by the birth dynamics, the Caesarean and the operative modes apparently determining the thinnest and the thickest lines, respectively.

By using the histological record from a deciduous dental sample (exfoliated crowns) of 100 modern healthy school-aged children (47 males and 53 females) of reported birth histories (normal delivery mode: 55 cases; Caesarean: 40; operative: 5), we investigated the relationships between birth dynamics and NL thickness variation. The Tukey Honest Significant Difference method has been used to test the differences between the means of the grouping levels.

The results of our histo-morphological investigation do not support the suggestion that Caesarean-born children display, on average, a thinner enamel scar compared to children associated to a normal delivery mode. Rather, our study supports the view of a stronger influence exerted by factors intimately related to gestational length variation on the degree of expression of the line.

Comparative first metatarsal head trabecular bone ontogeny in African apes and humans.

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Hallucal propulsion at toe-off is a distinct feature of mature human bipedalism. As a means

of creating a stable metatarsophalangeal joint (MTPJ) for toe-off, collateral ligaments surrounding the 1st MTPJ tighten, producing high compressive joint forces. By comparison, toddlers have weak plantarflexors and lack a propulsive toe-off. This study tested the hypothesis that epigenetically-sensitive trabeculae in first metatarsal heads of juveniles differ from that of adults. High resolution X-ray computed tomography was used to analyze trabecular bone structural parameters within dorsal, central, and plantar volumes of interest (VOI) in juvenile human (1-4 years, n=6) and African ape (0-5 years; *Pan troglodytes* n=10, *Pan paniscus* n=2, *Gorilla sp.* n=7) first metatarsals. Juvenile data were compared to those of adults (Griffin et al. 2010).

Results support the hypothesis that trabecular bone structural parameters within the first metatarsal head differ between juveniles and adults. Among all juveniles, humans had the highest DA in both dorsal and plantar VOI. In African apes and humans, compared to juveniles, conspecific adults had a higher DA and a higher BV/TV. Relatively low DA in juvenile African apes is consistent with a more varied locomotor repertoire and foot function. A high DA in adult humans suggests that the close-packing of the MTPJ is associated with highly organized first metatarsal head trabeculae while the lack of a mature toe-off in juvenile humans and African apes of all ages is associated with more isotropic trabeculae. Results support the use of ontogenetic studies of pedal trabecular architecture when identifying bipedal correlates.

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Profiling primates: anatomical methods for data collection, analysis, and comparison.

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Standardized methods of dissection contribute to developing a comparative database for understanding primate adaptation and evolution. In this poster we visually represent how we partition the individual into its dissectible body segments on one side of the body and analyze them relative to total body mass (TBM). On the other side, individual muscle weights are analyzed according to functional groups. To illustrate our dissections and methods we highlight with three comparisons: *segment masses* between infant, juvenile, and adult gibbons of the same sex and species but of different body masses (*Hoolock leucoedys*); *muscle groups* between infant and adult gibbons; and *limb proportions* between monkey and ape (*Macaca* and *Hoolock*). Juvenile gibbon limb segments are relatively heavier than either infant or adult (infant forelimbs: 16.8% (TBM), hindlimbs 15.6%; juvenile forelimbs, 20%, hindlimbs, 21%; adult 16.5%, 16.0% respectively). Hands and feet are heaviest in the infant (hands, 26.7% of limb segment mass; feet, 23.8%), lightest in the adult (14.3%, 15.1%). In musculature, the gibbon infant has relatively heavier elbow, wrist and digital extensors than the adult. The infant gibbon contrasts with infant macaques in limb proportions, whose forelimbs are 11% TBM,

hind limbs 15.8%, and tail, 1.1%. These methods allow comparisons of equivalent anatomical elements between individuals and are a basis for generating hypotheses about 1) life stage adaptations, e.g., infants have muscular hands and feet for grasping; 2) species-specific locomotor adaptations, e.g., quadrupedal monkey vs. suspensory ape, and 3) evolutionary change across taxa through modification of growth patterns.

Fire and tools: combining animal and human experiments to study food processing and cranio-dental integration.

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How has food processing affected human cranio-dental morphology and integration? Here we test the hypothesis that food processing has led to a reduction of both cranial and dental size and in modern, urban societies has produced a less integrated cranio-dental complex. We also discuss the necessity of combining controlled animal experiments with comparative human studies to test integration hypotheses. Experiment 1: Cranio-dental morphology of two human skeletal populations, one agricultural (dated ~1531-1831) and one more modern and urban (dated ~1910-1988), was quantified with 3-D landmark and 2-D caliper measurements. Early results indicate that dietary changes, presumably to more processed foods, have decreased skull size and increased shape variance. Experiment 2: Eight 6-week-old standard pigs were fed either a hard (normal chow) or soft (water-softened chow) diet *ad libitum* and received bi-monthly injections of Calcein, a fluorescent mineral label. After 12 weeks, the animals were sacrificed, skulls cleaned and M1 and M2 sectioned. Results suggest that consuming softer food changes skull shape, reduces corpus size and slows dentin secretion rates (which may result in smaller teeth). Together, these two complimentary studies support our hypotheses and highlight the importance of combining animal models with human studies to test human evolutionary theories.

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Testing the immunocompetence handicap hypothesis (ICHH) in both sexes of wild brown mouse lemurs (*Microcebus rufus*).

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Testosterone is thought to be an underlying cause of immunosuppression in males. It results in costly secondary sexual characteristics which compete with the immune system for resources, leading to an increase in parasite intensities. This is widely known as the

immunocompetence handicap hypothesis (ICHH) and has been examined extensively (with conflicting results) in numerous organisms in both captive and wild conditions. However, these studies have only examined the parasitic response to testosterone in males. We previously found that in the wild, female brown mouse lemurs (*Microcebus rufus*) have testosterone levels comparable to the males of the species which possess elaborate secondary sexual characteristics. Here we test to see if the ICHH applies to both sexes, by comparing testosterone values to ecto- and endoparasite intensities. Data was collected from August 2008 through November 2009, and samples were analyzed for fecal testosterone (n=541) at the Wisconsin National Primate Research Center using enzyme linked immunoassays. Our results show that while males do experience an increase in ectoparasite loads during the breeding season, there is no correlation between fecal testosterone and ecto- or endoparasite load. Similarly, fecal testosterone in females shows no significant trend fitting the ICHH. We found that during the breeding season males experience a dramatic increase in ectoparasite loads, but our data fail to support testosterone as the primary underlying cause of this mechanism. Instead we suggest a much more complex cause of decreased immunocompetence in males.

Overall health and the pathophysiology of tertiary syphilis.

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While many of the long-standing historico-scientific questions about syphilis approach resolution, several of the disease's compelling mysteries remain, including that of why its manifestations, particularly the destructive, dangerous (and skeletally identifiable) ones associated with tertiary stage disease vary so greatly between individuals. Investigations largely ground to a halt with the antibiotic era and due to the pathogen's resistance to being cultured, much about its pathogenesis and virulence mechanisms remains unknown. As several pre-antibiotic era studies suggested a destructive synergistic relationship between syphilis and other sources of morbidity, this study assesses potential associations between skeletal indicators of overall health, specifically linear enamel hypoplasias (LEH), periodontal disease, and caries, and the presence of tertiary infection, and, in individuals with

tertiary infection, the extent of tertiary manifestations and the type of syphilitic lesions expressed. Results from an analysis of syphilitic (N=24) and non-syphilitic, control skeletons (N=160) from multiple late medieval English samples suggest that the pathophysiology of syphilis varies in relation to overall health. Specifically, significant co-variation between the presence of LEH and syphilis aligns with other studies demonstrating that early life experiences may play a critical role in creating differential susceptibility to chronic disease in later life, though the causal mechanism here remains ambiguous. In addition to informing paleoepidemiological studies on the heterogeneity of frailty, given the increased global incidence of syphilis, these findings are potentially germane to contemporary public health; even with modern diagnostic capabilities, variation in the presentation of syphilis can greatly impede diagnosis and treatment.

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