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account for some statistical interdependencies inherent to relational network data. Here we use 21 years of behavioral data from Gombe from 23 adult males with known mothers, 10 of whom also had known fathers assigned via genetic sampling, to investigate the effect of kinship on cooperation. Employing additive and multiplicative effects (AME) models, a Bayesian random effects regression framework for relational data, we found that, as well as maternal brothers, both father-son and paternal brother dyads associated and groomed preferentially, and groomed more equitably, than unrelated dyads, even after accounting for individual age and rank, dyadic age and rank similarity, and individual grooming and association tendencies. Paternal and maternal kinship effects were of a similar magnitude. These results suggest that the ability to recognize paternal kin may be widespread in chimpanzees, and that kin selection likely plays a larger role in cooperation among male chimpanzees than previously thought.

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Phylogeny of Extant Colobines Using Morphological Data

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We conducted a cladistic analysis of extant colobines using morphological data, as the last such analysis was published twenty years ago by Jablonski (1998). The sample included all commonly recognized extant African and Asian genera including *Colobus* (n=51), *Procolobus* (n=9), *Piliocolobus* (n=58), *Simias* (n=20), *Nasalis* (n=21), *Rhinopithecus* (n=11), *Pygathrix* (n=9), *Presbytis* (n=110), *Trachypithecus* (n=60), *Semnopithecus* (n=11) and *Kasi* (n=13) treated as a separate OTUs. *Macaca* (n=199), often considered the most morphologically primitive papionin, was the outgroup. We included all of the characters that could readily be applied to colobines from Gilbert's (2013) cladistic analysis of papionins, including 52 quantitative dental, 33 quantitative cranial, and 67 qualitative characters. Quantitative characters were scored with gap weighted coding. We tested all characters for allometry, and affected characters were treated as described by Gilbert (2013). Three analyses were conducted: males only, females only, and sexes pooled. Matrices were assembled with Mesquite and analyzed in TNT using parsimony. The pooled sex analysis recovered a single most parsimonious tree with a monophyletic Presbytina, but Colobina was paraphyletic. The Asian colobines included an odd-nosed clade, but the langurs were paraphyletic. *Kasi* was sister to *Trachypithecus.* Sex-specific results were similar, except in the male analysis *Piliocolobus* was basal to the odd-nosed clade within Presbytina; and in the female analysis *Colobus* was basal to the odd-nosed clade within Presbytina. The position of *Kasi* in the sex specific analyses was unstable, but always among the other langurs. Future research involves increasing outgroup diversity to include more cercopithecines and incorporating fossils.

Investigating fossil hominin climbing behaviors: Novel applications of existing technology

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The retention of climbing-adapted features in the upper limb of some species of fossil hominins have historically been interpreted to indicate the continued relevance of arboreal climbing in the human lineage. Recent paleoenvironmental reconstructions for two major hominin-bearing landscapes in Africa have found that fossil hominins were preferentially utilizing landscapes featuring a mosaic of habitats in close geographical proximity, including dry, uplifted flanks with rocky cliffs. Many extant species of primate use rocky and cliff habitats as sleeping, foraging, and refuge sites. This raises the question: could the retention of climbing-advantageous morphologies in fossil hominins relate to behaviors other than tree climbing, such as rock climbing?

Five healthy, experienced rock climbers were recruited to perform two rock climbing and two suspensory grips on a custom rig. Kinematic analysis (Qualisys Motion Capture Systems, Gothenburg, Sweden) was used to quantify differences between suspensory and rock climbing grips in terms of joint angles, or grip shape. Pilot data was analyzed using principal components analysis and canonical variate analysis to assess variation within the samples. Results indicate significant differences between angular joint configurations according to grip type ($p = <0.007$). The only paired grip comparison without significant effects was the Hook-Power grip comparison.

The pilot study justifies a more detailed exploration of force distribution and kinematics between rock climbing and arboreal climbing/suspensory grips. We also present a novel approach to instrumenting complex vertical substrates using 3D printing technology to accurately collect kinetic data during non-arboreal climbing behaviors in modern humans.

This pilot study was supported by funding from the Quaternary Research Center.

Exploring age-related variations during talar growth

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Age estimation is a fundamental aspect in juvenile osteological studies and, as such, there are many methods that rely on ontogenetic-related changes to bone morphology. The talus, being a small and compact bone, is generally well preserved in archaeological contexts, but little is known about its morphological trajectory during growth. To better understand this we apply a (semi)landmark-based approach to an ontogenetic sample of 26 modern human juvenile tali (known age/sex = 12; unknown age/sex = 14), grouped by 5 age categories ranging from 0 to 15 years.

A template of 11 landmarks and 205 semilandmarks were applied to 26 microCT-based digital models of the juvenile tali. These were superimposed by Generalized Procrustes Analysis with the semilandmarks freely sliding against recursive updates of the Procrustes consensus. Finally, individuals of unknown age/sex were projected into the form-space determined from a Principal Component Analysis of the known sample.

Our results show that most of the morphometric variation is explained by PC1 (≈91%), which is highly correlated with size and accounts for ontogenetic allometry. Negative scores (i.e., youngest) are related to a small and globular morphology. The positive scores (i.e., oldest) account for an elongation of the talar body, which is mainly related to the development of the neck and growth of the lateral malleolar facet.

Overall, our preliminary results suggest that age-related morphological variations of the talus may be used to determine the general age of juvenile skeletal remains, which could be valuable to many archaeological and forensic researchers.

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ED-XRF study of Oldowan artifacts documents raw material selection and transport through time on the Homa Peninsula, Kenya

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At the earliest Oldowan occurrences (2.6 – 2.3 Ma) the degree of raw material selectivity is variable and materials were transported over relatively short distances. This is in contrast with sites 2.0 Ma and later where hominins frequently selected and transported materials from further afield. This shift is apparent at Kanjera South (KJS), Kenya (ca. 2 Ma) where toolmakers preferentially selected durable lithologies from non-local sources providing evidence for the earliest habitual transport of raw materials over long distances. At Nyayanga, an older locality that is also on the Homa Peninsula, hominins also selected durable materials such as rhyolite (40.4% of assemblage), quartz (29.9%), and quartzite (27.2%). Trace element geochemistry obtained from X-ray fluorescence spectroscopy indicates that rhyolite and quartzite artifacts came from the same primary sources as those previously identified for KJS. While some rhyolites may have been locally available to KJS and Nyayanga hominins, previous research suggests that quartzite was not locally available. A 2018 survey of nine paleo-conglomerates confirmed that secondary drainages carried quartzite in low frequency (<2%) four kilometers away from Nyayanga, and quartzite was not represented in conglomerates surveyed within the four-kilometer radius. Thus, Nyayanga toolmakers exhibited similar raw material preferences to KJS hominins, choosing durable lithologies that link to the same primary sources and traveled surprisingly long distances to obtain these materials. This reveals continuity in the raw material selection and transport behaviors of hominins on the Homa Peninsula through time, and extends the record of habitual transport of non-local materials for flake production.

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Evaluating Osteon Cement-Line Interface Distances for Advancing Understanding of Bone Adaptation

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Secondary osteons (SOs) help avoid fracture because their cement lines (CLs) slow microcrack propagation. At the 2018 AAPA meeting we reported a new characteristic for evaluating this function: distances between the CLs of SOs, in net compression on one cortex and tension on the other (tension is more deleterious). CL interface distances (CL-Int-d) might evaluate this 'toughening mechanism' more adequately than only osteon population density (OPD), size, and shape because it accounts for osteonal variants (e.g., drifting SOs) and fragments. In 2018 we evaluated only medial (compression-region) and lateral (tension-region) cortices of chimpanzee femora (subtrochanteric) where bending is high. Here we also evaluate anterior (A) and posterior (P) cortices (these approximate a neutral axis). We also evaluated CL-Int-d with a denser grid and two orthogonal orientations; hence a more robust analysis. 12 adult femora (subtrochanteric) were also evaluated. Circularly polarized light images were used and CL-Int-d measured from CL tracings. Data were compared to regional variations in OPD, osteon size, and predominant collagen fiber orientation (CFO). Surprisingly, the chimpanzee femora had CL-Int-d that were greater in the medial cortex vs. the lateral cortex (in 2018 we reported these as equivalent)--this can be explained by the more robust analysis. The findings are now more logically related to the smaller SOs in the medial cortex. Human femora had equivalent CL-Int-d's in M-L cortices, which logically corresponds to their similar osteon size/OPD. Therefore, the new characteristic might not supplant conventional osteon-related measures as correlates for studies of bone adaptation in a bending environment.

Diet and Catastrophe: Dental Microwear Analysis of a Population Under Siege at the Ancient Greek Colony of Himera

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We analyze the occlusal dental microwear of individuals believed to have died during the siege and subsequent destruction of the ancient Greek colony of Himera, Sicily, in 409 BCE to evaluate diet disruptions in times of warfare. Occlusal microwear features, caused by mastication, reflect diet at the end of an individual's life, and in this case likely reflect diet of individuals affected by the Carthaginian invasion in 409 BCE. We examine molars from nine soldiers who died in the 409 BCE battle and nine citizens whose skeletal trauma and hasty graves suggest they were battle casualties (the catastrophic assemblage), as well as 14 individuals in tile-capped graves who died in the late 6th to 5th centuries BCE unassociated with destruction of the city (the attritional assemblage). Sputter-coated epoxy casts of molars were viewed at 500X with a Teneo field emission scanning electron microscope. Micrographs of the disto-occlusal facets were analyzed using Microwear 4.02 software. Results indicate that number of pits is greater in soldiers and citizens who died during the city's destruction than citizens in the attritional sample, suggesting that leading up to battle, people consumed a harder diet. This difference in diet between times of war and peace is likely due either to disruption of resource supply, or seasonal differences in resource availability. This study supports the interpretation of hasty graves as catastrophic deaths, expands knowledge of the last days of Himera, and contributes to our understanding of the strategies of ancient communities in the face of warfare.

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Neanderthal Hypercarnivory Revisited – Experimental Study of $\delta^{15}N$ Shifts in Dietary Items Produced by Various Cooking Techniques

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Nitrogen isotope ratios are used frequently in paleoanthropology and archaeology as an indicator of dietary composition. When this method is applied to collagen preserved in Neanderthal long bones, results show a highly enriched $\delta^{15}N$ signal across multiple individuals and sites. Traditionally, paleoanthropologists have attributed this to hypercarnivory, in line with or exceeding the $\delta^{15}N$ values of contemporaneous carnivores in the same sites. However, recent work on Neanderthal dental calculus and other dietary proxies indicates that the Neanderthal dietary repertoire is much more varied, including a number of plant foods. Reconciling the $\delta^{15}N$ isotopic results with other dietary indicators necessitates an alternative explanation for the highly enriched $\delta^{15}N$ signal. This study explores an alternative dietary mechanism from which a $\delta^{15}N$ signal akin to those seen in Neanderthals could result. We