The numerical composition of the vertebral column has generated newfound interest in recent years, particularly regarding its role in the evolution of hominin primates, in large part due to the implications for hominin origins and the evolution of bipedalis. Recently, several different scenarios were proposed to describe the modal number of lumbar vertebrae possessed by the last common ancestor (LCA) of humans and chimpanzees. These include a "chimpanzee-like" ("short-back") ancestry, a "Pan-like" ("long-back") ancestry, and a "human/gibbon-like" ancestry. Initial interpretations of Ardipithecus ramidus support the long-back scenario, although the ARA-VP-6/500 skeleton does not preserve sufficient remains to assess vertebral counts.

I test these competing hypotheses using a combined dataset of published vertebral formulae for both extinct and extant mammals, supplemented with my own data (total N=5,600 specimens). Modal ancestral vertebral formulae are reconstructed throughout mammalian evolution and the hominoid vertebral column is placed in this large phylogenetic framework. Results suggest that a 7-13-6-3 (cervical-thoracic-lumbar-sacral) vertebral formula evolved in the ancestor of thiran mammals and persisted throughout mammalian evolution, including the LCA of catarrhines. The LCA of crown hominoids achieved a 7-13-5-4 formula through a caudally-directed homoeotic shift at the lumbo-sacral border, a rare occurrence among mammals. The LCA of hominids experienced a subsequent shift at this border, rendering the vertebral formula 7-13-4-5, a "great-ape-like" pattern that persisted through to the hominin-pamin LCA. Therefore, this study supports a short-back, "short-trunk" scenario of hominin ancestry. Implications for orthograde, bipedalism, and hominin evolution are discussed.

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Species differences in the rate of cognitive ontogeny among humans, chimpanzees, and bonobos.

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Patterns of cranial development vary significantly between humans and our closest living relatives, chimpanzees (Pan troglodytes) and bonobos (Pan paniscus). Humans have been proposed to undergo a greater degree of cranial growth postnatally in comparison to the genus Pan, while in turn bonobos appear to exhibit delayed development in certain aspects of their crania relative to chimpanzees. Little data currently exists to test whether these changes in cranial ontogeny are associated with changes in behavioral or cognitive ontogeny. Here we compare the cognitive development of human infants (n = 48), chimpanzees (n = 138), and bonobos (n = 50), utilizing a battery of over 10 tasks examining a wide range of cognitive abilities. We test two hypotheses: 1) human cognitive development is accelerated relative to that of Pan in infancy and 2) bonobo cognitive development is delayed relative to that of chimpanzees. We found that human infants show accelerated cognitive development between 2 and 4 years of age, likely owing to an early emergence of social cognition abilities relative to Pan infants that allows for participation in human culture.
also found that bonobos exhibited delayed cognitive development relative to chimpanzees, though only in physical cognition skills (those employed in foraging or reasoning about objects). These results suggest that differences in cranial ontogeny in hominoids are associated with significant differences in cognitive ontogeny. Further work should integrate studies of behavioral and physiological development as part of a larger evolutionary-ontogenetic approach to understanding human evolution. This work was supported in part by a European Research Council Advanced Grant Agreement 233297 and National Science Foundation grant NSF-BCS-08-27552-02 to B.H., and an L.S.B. Leakey Foundation Grant, NSF DDIG 0851291, and Wenner-Gren Foundation Grant to V.W.

Co-associations of subsistence strategy, non-specific infection, and congenital defects of the deciduous dentition in pre-Columbian Tennessee.

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Defects of the deciduous dentition flag prenatal stress which may predispose children to postnatal chronic health problems. These chronic health problems may be skeletally manifested as periostitic or osteoporotic changes in the cranial and postcranial skeleton, and compromised growth of the long bones. The subadults which possessed deciduous dentition (skeletal <7 years of age) from 7 sites (N=386) from the agriculture-intensive Late Mississippian (AD 1300-1550) period of East Tennessee were compared to the same skeletal age cohort from 5 sites (N=111) dated to the Late Archaic (3000-100 BC) period of west-central Tennessee. Despite the problems associated with the differential preservation of skeletal material, results indicate a higher frequency of chronic health problems in the maize-dependent Late Mississippian (32 indicative cases), with 13 of those individuals also demonstrating long bone involvement (13 indicative cases). The Late Archaic hunter-gatherers demonstrate a higher frequency of long bone involvement: 9 indicative cases out of 10 subadults with chronic conditions. When the co-association of chronic infection and dental defects was examined, results indicate that 28 (7%) Late Mississippian and period subadults displayed gross enamel defects, 10 of which also demonstrated chronic infection. In contrast, the Late Archaic sample indicate a much lower frequency of dental defects (3%) with only 1 case co-associated with chronic stress. These results suggest that factors which contribute to this settlement and subsistence difference, which include fundamental community health differences linked to sedentism and population density, likely contributed to a higher co-association of non-specific infection and deciduous defects in the Late Mississippian.

Ontogeny of limb growth and locomotor behavior in Lemur catta and Propithecus verreauxi.

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Propithecus verreauxi and Lemur catta differ in adult locomotor behavior and morphology, especially in terms of specializations for hind- or dominant locomotion. However, little is known of the ontogenetic trajectories by which these adult forms are acquired. We examined changes in locomotor behavior and limb morphology from 0-2 years in L. catta and P. verreauxi. Limb segment lengths and body mass were recorded every two weeks (infants) or four weeks (yearlings) at the Duke Lemur Center (DLC). Locomotor data were collected on infants and yearlings of each species in free-ranging enclosures at the DLC using locomotor bout sampling. Bouts were classified as hindlimb, forelimb, or "all-limb" dominant locomotion. Positive allometric growth was observed in all limb segments (except L. catta radius) and was highest in femur length from 0-6 months in both species. No significant differences in allometric growth were found between species or age classes. Propithecus have significantly longer limb segment lengths than L. catta during infancy, and both species have relatively higher intermembral indices during 0-6 month versus 6-12 months of age. More hindlimb dominant locomotion was observed in L. catta as infants than yearlings. No differences were observed in locomotor behaviors between P. verreauxi infants and yearlings. L. catta displayed higher frequencies of all-limb locomotion than P. verreauxi in all age classes. Growth trajectories were similar between species, yet initial limb segment lengths and locomotor behaviors differed between species across age classes. These data suggest that differences between species in adult body proportions may be established early in neonatal life. This study was partially funded by Sigma Xi Grants-In-Aid of Research G2009151076.

Keeping their friends close? Contrasting models of social associa-
tion in Hadza hunter-gatherers.

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Because spatial proximity is necessary for most forms of social behavior, friendships and other "close" relationships are likely to be expressed in patterns of space use. While primatologists often explicitly model the social structure of a species or population in terms of space use, researchers studying human populations are much less likely to do so. Primatologists and other biologists often use observations of social interaction and grouping to create inductive models of social structure, from which individuals' preferred social partners can be inferred. In contrast, anthropologists and sociologists typically use interview data to create deductive models of social structure based on nominations of important social relationships, such as friendships. This paper will compare models of Hadza hunter-gatherer social structure derived from both methodologies: direct measures of social grouping as recorded by GPS devices worn by subjects, and the same subjects' nominations of who their friends were. 11 men and 14 women living in 2 Hadza camps in 2010 wore GPS devices daily for two weeks. We use measures of space use to model the strength of social association between individuals. The same subjects were asked to name who their closest friends in camp were. Both GPS data and interview responses reveal a strong preference for social association with same-sexed individuals. We examine the spatial correlates of strong and weak friendship ties, and test whether husbands and wives can be identified through patterns of spatial proximity. This study was funded by NSF BCS 0850815.

Phylogenetic signals in the hominoid carpus.

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The carpal skeleton has been an important region in studies of hominoid anatomy. It is the product of functional, developmental and phylogenetic processes and therefore many carpal traits would be expected to exhibit mixed signals. The question asked in this study is: which carpal characters exhibit a high-level of phylogenetic structure? Nineteen metric and seven categorical characters were collected from the capitale, hamate, lunate, triquetral, pisiform and scaphoid. Ten extant anthropoid taxa (n=253), including six hominoid species, were sampled. Individual