Body temperature estimates for Bornean orangutans (*Pongo pygmaeus wurmbii*) from internal fecal temperature measurements

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Monitoring health status is a critical aspect of primate conservation, yet can be difficult to noninvasively investigate in the wild. Because mammals are endothermic, body temperature can be used as a health marker for primates. Using a method previously tested on chimpanzees and humans, we estimated body temperature of wild Bornean orangutans by measuring the internal temperature of fecal sample. Upon quickly collecting a fecal sample after defecation, we recorded internal temperature of the sample at 20-sec intervals for six minutes. Data included a series of temperatures for each sample that we fitted to a sigmoid curve, which was used to estimate body temperature. Estimated body temperature was not affected by sex ($F(2,92)= 0.431$, $P= 0.651$), weather ($F(2,92)= 1.175$, $P= 0.313$), or collection time ($r= -0.074$, $N= 95$, $P= 0.468$). Estimated body temperature was higher for fecal samples that fell from lower estimated heights ($r= -0.23$, $N= 95$, $P= 0.0004$) and were heavier ($r= 0.23$, $N= 75$, $P= 0.0475$). We compare these results from the field to captive fecal samples, taking place on the ground, to determine the accuracy of this field method. From our field samples (N=95), orangutans appear to have a lower internal body temperature (33.44 ± 1.74 °C) on average than either chimpanzees or humans. Previous studies have demonstrated that orangutans have a lower metabolic rate than other great apes. Lower body temperature may serve as a metabolic adaptation of orangutans to survive extended periods of low food availability when energy needs to be conserved.

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Deforming feet, deforming substrates: 3D dynamics of the human foot during footprint formation revealed through biplanar X-ray methods

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Fossil hominin footprints record unique data on foot anatomy and biomechanics that can provide critical insights into the evolution of human bipedalism. Accurately interpreting these data, however, requires parsing complex mechanical processes through which a final footprint arises. Neither the substrate nor the foot is rigid, hence they continually respond to each other's changing shapes, motions and forces, resulting in a final footprint that is not a simple, linear representation of foot anatomy or kinematics.

Here, we apply new biplanar X-ray and 3D animation methods to study dynamic foot-substrate interactions during human track formation. Seven subjects walked across four substrates (three deformable muds and solid carbon fiber) with radiopaque markers adhered to the external surfaces of their feet. Marker 3D motions were used to visualize and quantify continuous interactions at the foot-substrate interface. We found that soft tissue deformation, and the motions that define standard gait phases, differ markedly across substrates. For example, heel strike is a discrete impact event that causes significantly greater vertical compression of the heel pad on rigid substrates. However, the heel deforms significantly less and sinks for significantly longer, often into midstance, on compliant muds. These and other differences in 3D foot dynamics across substrates encourage us to reconsider the interpretive frameworks commonly used to analyze fossil footprints. We suggest that process-based analyses (e.g., computer simulation to understand how footprint shapes form) may be more fruitful than exclusively product-based analyses that only compare final footprints to each other.

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Interobserver Agreement in Scoring Dental Morphology using ASUDAS in South Australian Whites

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Despite standards for scoring dental morphological trait expression, accuracy varies based on an observer's level of experience. Previous studies show the application of each trait for assessing ancestry in various populations, but they have yet to identify which traits multiple observers more accurately record. This research focuses on scoring traits from photographs of dental casts from South Australian whites (n=224). Each cast had a series of photographs that allowed for observations on shoveling on the upper incisors, tuberculum dentale (TD) on the upper canines, distal accessory ridge (DAR) on upper and lower canines, hypocone on upper M1 and M2, Carabelli's cusp on upper M1 and M2, and lingual cusp number on the lower premolars. Eight observers with varying levels of experience (ranging from little experience to expert) were randomly assigned dental traits to score the entire sample, resulting in between three and five observers per trait. All scores were based on the Turner-Scott Dental Anthropology System (ASUDAS). Agreement was calculated by reporting the greatest to the least variance between any two observers, when a difference in scores within one ASUDAS grade was considered to be in agreement. Shoveling ranged from 95-100% agreement between observers; TD from 80-94%; DAR from 72-92%; hypocone from 85-99%; Carabelli's from 68-96%; premolar cusp number from 71-88%. This study demonstrates traits vary in observer agreement. Traits observed by multiple levels of experience resulted in the largest ranges. Results suggest certain traits can be assessed with high accuracy, but variation in observer experience affects interobserver agreement.

Temporal clustering of sexual contacts can maintain endemic sexually transmitted virus in mobile subsistence populations

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Parameterizing contact patterns that drive pathogen transmission is critically important for building useful predictive models, but contact behavior is highly complex, especially sexual contact. Most sexual contact rates for epidemiologic modeling are based on partner exchange rates only, assuming that per-partner rates of sexual contact are equal and that sexual contact is evenly dispersed in time. These assumptions are broadly unrealistic, especially when subsistence mobility has a strong influence on the spatial and temporal distribution of people and their sex partners. Our fieldwork among semi-nomadic pastoralists in Kaokoveld, Namibia showed that seasonal subsistence mobility influences access to sexual partners and sexually transmitted infection (STI) exposure. In Kaokoveld, mild partner concurrency is culturally normative, contact rates vary within and between partnerships, and per-partner contact is highly temporally clustered.

Motivated by these observations, we hypothesized that temporal variability and clustering in sexual contact has significant impacts on STI dynamics, particularly for viruses with low transmission probabilities, like herpes simplex virus. We built an agent-based model of sexual mixing based on our detailed sexual network data from Kaokoveld (2015–2016), and we incorporated epidemic processes of common viral STIs to compare epidemic outcomes with and without temporal clustering of per-partner contact. We found that, even during high-dispersal periods,