



**Center for Academic Research & Training in Anthropogeny (CARTA)  
Birth to Grandmotherhood: Childrearing in Human Evolution**

**Friday, February 21, 2014  
Public Symposium**

**Chairs:**

***Kristen Hawkes, University of Utah • Wenda Trevathan, New Mexico State University***

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**ABSTRACTS**

***Birth and the Newborn Infant***

**Wenda Trevathan, New Mexico State University**

The high degree of dependency at birth and an inordinately slow rate of growth of human infants and children place demands on mothers and other caretakers that appear to far exceed those of other mammals, including our closest primate relatives. What role do gestation and birth play in producing these highly dependent and slow growing infants that require investment from a variety of caretakers and numerous life history trade-offs? This presentation will focus on energetic and biomechanical factors that converge at the time of birth to set the stage for an enormously expanded role of childrearing in human evolution. For example, human maternal metabolism approaches its limit after about nine months of gestating a rapidly growing fetus with an exceedingly hungry brain. This limit is among the constraints placed on infant developmental stage, requiring birth at a relatively immature point along the fetal-infant growth continuum. Additionally, a somewhat narrow and rigid pelvis offers further resistance to birthing an infant with more advanced brain and cranial development. These challenges, requiring birth of an immature and highly dependent infant, are met through the extensive and costly caretaking that characterizes our species.

***Infant State in Apes and Humans***

**Kim Bard, University of Portsmouth, UK**

What are the inborn capacities of chimpanzees? How do chimpanzees compare to humans? These questions typify the long-standing interest in "what makes us human." As a developmental psychologist, I am interested in describing the developmental process, and as a comparative psychologist, I am interested in comparing development in chimpanzees with development in humans. In this talk, I will present data on comparative development of infant states, that is, states of arousal, state regulation, emotion states, and engagement states in chimpanzee and human infants. For example, within the first 30 days, chimpanzees raised in a human nursery develop the ability to maintain a quiet and alert state for minutes when out of physical contact (significantly longer than human infants from Providence, RI). Chimpanzees raised by their chimpanzee mothers, however, are significantly less able to regulate their attentive state when out of physical contact compared to human infants and to nursery-raised chimpanzees. Thus, state regulation systems in chimpanzees are sensitive to caregiving variables and these effects are manifest very early in development. Within the first 3 months, rearing effects are dramatic in the preferred modality of engagement states in chimpanzees. In some chimpanzee groups positive face-to-face interactions (visually-based mutual gaze) emerge from 6-8 weeks of age, whereas in other groups, close physical contact (tactile-based cradling) is the preferred modality for mutual engagement. This interchangeability in the modality of engagement state is found also among humans, exclusive dyadic attention is valued in Euro-American settings, whereas physical contact and shared attention, among various people and activities, is valued in interdependent cultures. Comparative developmental studies are valuable for understanding hominid evolution, and essential for delineating those characteristics that are uniquely human.

***Breast Milk and Breastfeeding***

**Katie Hinde, Harvard University**

Milk is abundant at our local grocery store in the form of dairy products and infant formulas. This ubiquity of homogenized milk in our modern environment has the potential for the general public, and even researchers, to think of milk unidimensionally. Milk is not just food, however, but is also medicine and signal. Hundreds, possibly thousands, of other milk "bioactives" provide immunity and physiological regulation for the infant. Importantly, milk is not uniform across mothers or within an individual mother across time. Maternal health, nutrition, culture, reproductive history, early-life conditions, and genes all contribute to differences in milk composition. Less understood are the consequences of that variation for infant development and fitness outcomes. Here I will present emerging research that addresses the magnitude, sources, and consequences of inter-individual variation of bioactive constituents in mother's milk. A better understanding of variation in milk composition, especially for

milk constituents linked to infant cognition, neurodevelopment, behavior, and metabolism, enhances an evolutionary biological perspective of parent-offspring dynamics. Moreover, biological and social scientific research on this topic can be directly translated into more personalized clinical recommendations and health optimization for mothers and their infants. Identifying the composition and function of milk informs the manufacture of more representative infant formulas, the importance of institutional support, and the necessity for greater advocacy for mothers.

### ***Oxytocin Pathways and Human Evolution***

**Sue Carter**, University of North Carolina, Chapel Hill

This presentation examines the hypothesis that *Homo sapiens*, with their high level of dependence on social behavior and cognition, could not have evolved without the neuropeptide, oxytocin. Oxytocin pathways - which include oxytocin, the related peptide vasopressin, and their receptors - are at the center of physiological and genetic systems that permitted the evolution of the human nervous system and allowed the expression of contemporary human sociality. Unique actions of oxytocin pathways, including the facilitation of birth, lactation, maternal behavior, extended periods of nurture, genetic regulation of the growth of the neocortex, and the maintenance of the blood supply to the cortex, were necessary for primate encephalization. In general, oxytocin permits the high levels of emotional sensitivity and attunement necessary for rearing a human child. Under optimal conditions oxytocin may create a physiological metaphor for safety, experienced as sensations and emotions, which are fundamental to human social behaviors. Together these form a substrate for the emergence of human intellectual development and eventually complex societies and cultures.

### ***Sharing Childcare and Knowledge in Infancy***

**Barry Hewlett**, Washington State University, Vancouver

Giving and sharing are central to understanding humanity and human evolution. The talk examines reproductive (i.e., allomaternal care) and information (i.e., knowledge and skills) sharing among Aka hunter-gatherers of the Congo Basin. Particular attention is given to understanding the contexts of allomaternal nursing and teaching during infancy.

### ***Human Fathers***

**Hillard Kaplan**, University of New Mexico

In this talk, I will present a theoretical model linking ecology to male paternal investment. The basic argument is that there are three fundamental potential inputs into offspring fitness: genes, care, and energy. The ecological niche to which the population/species is adapted determines three important relationships: 1) the impacts of variation in each of those inputs on offspring fitness; 2) the degree to which those inputs are complements or substitutes; and 3) the extent to which provisioning of care trades-off against the provisioning of energy to offspring. The model predicts male paternal investment will be greatest when both care and energy have large and complementary impacts on offspring fitness, and when the amount of energy a single parent can provide trade-offs sharply with the care that parent can provide. It applies the model to large-scale cross-species variation in paternal investment and in the forms that it takes. The model is then applied to humans. It is proposed that there is a modal human economy of food production and redistribution that evolved as part of the hunting and gathering lifeway. Three fundamental social relationships organized the system of redistribution: 1) Intergenerational transfers from older to younger individuals, both from parents to offspring and from grandparents to grand-offspring; 2) Risk-reduction reciprocity among members of the same and different generations; and 3) complementarity between men and women in resource production and childcare. This economy favored the evolution of male paternal investment and the establishment of long-term pair bonds between men and women. As human economies changed over the last ten thousand years, both among and within cultural diversity in mating and parental investment has grown substantially. In particular, variance in earnings among men has grown substantially in some economies, resulting in stable polygyny (in which some men mate with more than one woman while other mate with none) or polygynandry (in which both men and women have more than one mating partner, simultaneously or serially). The same principles explaining diversity in nonhuman mating systems help explain the intraspecific diversity in humans.

### ***Hunter-Gatherer Childhood and Human Evolution***

**Melvin Konner**, Emory University

Even compared to other primates, we humans develop slowly, with high levels of parental and non-parental care. Research on infancy and childhood among !Kung (Bushman) hunter-gatherers of northwestern Botswana, the first hunting-gathering group where childhood was quantitatively studied, yielded a distinctive characterization of their patterns of child care and behavioral development, and surveys of prior ethnographic literature suggested that core features of these patterns were seen in other hunter-gatherers. Most of these

generalizations have held up well as infancy and childhood have been scientifically studied in other hunter-gatherers. This lecture contextualizes them in the light of recent advances in our understanding of the evolution of human life histories and against the background of basic primate adaptations for infant and juvenile care. Childcare in these cultures, which in some ways represent our environments of evolutionary adaptedness (EEAs), may help explain the success of our species.

***Grandmothers and the Extended Family***  
**Kristen Hawkes, University of Utah**

Conjugal families are often assumed to be building blocks of human societies and the primary site of childrearing in traditional communities. Alternatively, the Grandmother Hypothesis draws attention to other relationships likely fundamental in the evolution of our lineage. Persistent ties that crosscut conjugal families are implied by our cooperative childcare, distinctive prosociality, and extraordinary operational sex ratios.

Sarah Hrdy has highlighted the universality of human cooperative rearing and linked it to selection on ancestral infants that propelled the evolution of our distinctive preferences for joint attention. If cooperative rearing in our lineage began with grandmothing, then those distinctive social preferences evolved with extended family associations and another crucial shift.

The number of males competing for fertile females is much higher in humans than in other primates because our extraordinary longevity evolved in both sexes without extending female fertility to later ages. High operational sex ratios raise male payoffs for mate guarding. Yet, unlike mate guarding in other species, mates in traditional communities do not remain in constant close proximity. Conjugal families disperse daily into parties of women and children, men often in association with other men. Men's proprietary claims on particular women depend on acceptance of those claims by others; and ways men negotiate with other men affect the economics of child rearing.

***Born Human: How the Utterly Dependent Survive***  
**Sarah Blaffer Hrdy, University of California, Davis**

Hominin infants who needed to elicit care and provisioning from allomothers as well as mothers confronted a different set of challenges from those faced by their last common ancestor with other apes. Reliance on allomaternal assistance to rear young rendered mothers increasingly sensitive to signals of how much social support she and her offspring could expect, and multiple offspring with overlapping periods of dependency meant mothers might be forced to choose *between* offspring when investing. Paternal and alloparental responses to infants would also be facultatively expressed, depending on probable relatedness, alternatives available, past experience and degree of exposure to infantile appeals. Elsewhere I hypothesized that such an "unapelike" rearing system led immatures to develop novel phenotypes that over generations were subjected to directional social selection (*sensu* West Eberhard) favoring youngsters who at birth demonstrated good survival prospects and who over the course of development proved adept at monitoring the intentions, thoughts and feelings of potential caregivers so as to engage and appeal to them. Here, I rely on the best available proxies we have for humankind's last common ancestor with other apes (studies of chimpanzee and modern human infants) in order to test a key underlying assumption of this "Mothers And Others" model -- that contingent care from multiple others generates ape phenotypes with more fully expressed other-regarding potentials. In this way, without any foresight on Mother Nature's part concerning future pay-offs, raw material could become available for Darwinian selection to favor enhanced mutual understanding in the line of apes belonging to the genus *Homo*.