



anthropogeny tracks

a CARTA newsletter

Volume 1, Issue 3 - October 2013

Free Human Origins Symposium on “Theory of Mind”

The phrase “Theory of Mind” (ToM) has historically referred to the ability to impute mental states to oneself and others but has been used in a variety of ways during the 35 years since the original Premack and Woodruff paper (1978). The analysis of ToM has been the subject of many papers in developmental psychology and anthropogeny, the latter focusing on differences in mental performance between humans, other mammals, and birds.

CARTA’s October 18, 2013 symposium, “Mind Reading: Human Origins and Theory of Mind,” will examine the precise definition of ToM, followed by the ontogeny of human ToM, relevant information on other mammals and birds, and the neuronal correlates and mechanisms of human ToM performance. Co-Chaired by Donald Pfaff (Rockefeller University) and Terry Sejnowski (Salk Institute), this symposium features noted experts representing numerous fields of research from around the globe who will share their knowledge:

What is Theory of Mind?

Ralph Adolphs, California Institute of Technology

“Mind Reading” in Chimpanzees

Tetsuro Matsuzawa, Kyoto University

Comparing Apes and Dogs

Juliane Kaminski, University of Portsmouth

The Social Brain in Adolescence

Sarah-Jayne Blakemore, University College London

Reflections of Dolphin and Elephant Minds

Diana Reiss, Hunter College, City University of New York

Mirror Neurons and More

Michael Arbib, University of Southern California

Brain Imaging Studies

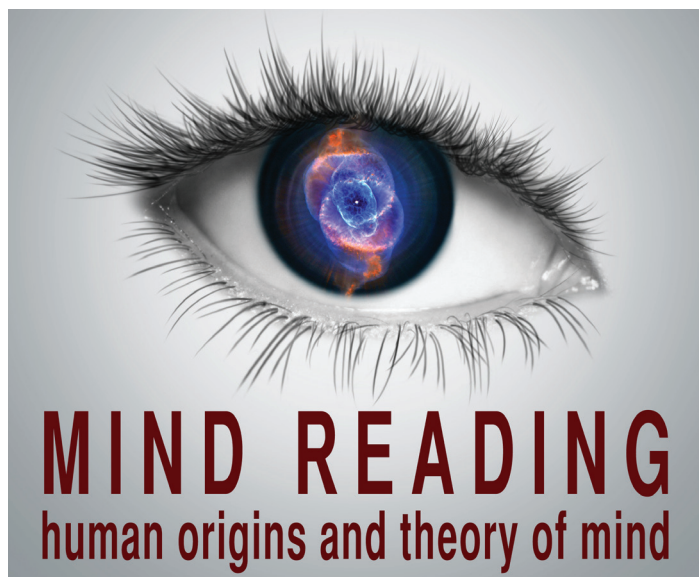
Jason Mitchell, Harvard University

Emergence of Theory of Mind in Human Babies

Jessica Sommerville, University of Washington

What Makes Humans Different?

Elizabeth Spelke, Harvard University



This CARTA symposium is made possible by
The G. Harold and Leila Y. Mathers Charitable Foundation
with generous support from
Rita and Richard Atkinson.

DATE AND TIME: October 18, 2013, 1:00 - 5:30 p.m., PT

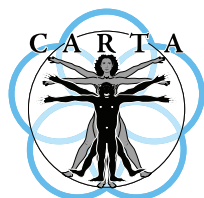
LOCATION: De Hoffmann Auditorium, Salk Institute

ADMISSION: Free, but online registration is required

WEBSITE: <http://carta.anthropogeny.org/events/mind-reading-human-origins-and-theory-of-mind>

WEBCAST: A live webcast will be offered. Look for details on the event page

For more information, contact CARTA at
carta-info@anthropogeny.org



Center for Academic Research and Training in Anthropogeny
“to explore and explain the origins of the human phenomenon”

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Synopses from Student Essays

Since the inception of the Anthropogeny Graduate Specialization at UC San Diego in 2010, participating graduate students have had the unique opportunity to “host” internationally renowned speakers during the thrice-yearly CARTA symposia proceedings. CARTA symposia provide

those students with an unparalleled opportunity to learn from and network with scientists who are on the forefront of human origins research. As part of the curriculum requirement, each participating student summarizes their assigned speaker’s presentation and ensuing discussions

into a written essay, which is vetted by the speaker and faculty who coordinate the Anthropogeny Specialization. Below are three synopses from student essays resulting from talks delivered at the May 2013 symposium, “Behaviorally Modern Humans: The Origin of Us.”

Kiri Hagerman Anthropology

Dr. Lyn Wadley (University of the Witwatersrand) examined evidence in South Africa related to the origins of human behavioral and cognitive modernity. Wadley highlighted several aspects of complex cognition such as the ability to multi-task, communicate symbolically, and understand processes, as well as the capability for flexible problem-solving, long-term planning, and delaying gratification. At Sibudu, a cave in South Africa, Wadley discovered evidence for the use of medicinal plants dating to 77 thousand years ago (kya) and evidence for snaring by 71 kya. The presence of etched ochre by 71 kya at Sibudu and Blombos, another cave in South Africa, and etched ostrich eggshell fragments from Diepkloof, near Johannesburg, at 100 kya indicate symbolic thought and the emergence of group and individual identity as early as 100 kya.

Wadley’s experiments recreating compound adhesives indicate an ability to multi-task, understand processes, delay gratification, and understand the concept of transformation by at least 70 kya, which is indicative of modern cognition. Evidence for heat-treated lithics is present as early as 164 kya at Pinnacle Point, which similarly indicates an awareness of the concept of transformation and an ability to make long-term plans and understand delicate processes. Wadley suggests that these attributes of complex cognition arrived incrementally and not together in one package, and places the start date for the emergence of complex cognition and behavioral modernity at least as far back as 164 kya.



Kiri Hagerman uncovering artifacts in Belize.

Corinna Most Anthropology

Dr. Iain Davidson (University of New England, Australia) outlined the cognitive steps that occurred in our lineage after it split from the other apes and suggested how to identify those steps in the archaeological record.

Davidson presented a model in which behaviorally modern humans possess 9 cognitive subsystems, with monkeys and apes possessing 5 and 6, respectively. It follows that our hominin ancestors evolved to possess 7 and then 8. Subsystem 7 increased cognitive control of the range of vocalizations allowed by the evolving hominin anatomy, and emerged ca. 2 million years ago (mya). Subsystem 8 controlled the coordination of utterances in response to visual stimuli, and appeared ca. 500 kya. Crucially, these subsystems increase the ability to process different events concurrently, and facilitate reorganization and abstraction of the inputs of different sensory modalities. Modern humans then added another layer of semantic abstraction. So, language is not just generative spoken communication, but is also able to produce and manipulate meaning.

Davidson argues that to identify these cognitive steps in the archaeological record, we must move beyond looking at the form of artifacts and focus on the cognitive processes necessary for their production. Fully modern cognition can be identified through evidence for symbolic thought and meaning in art, burials, and technological traditions; it can be seen in the production of artifacts that are obtained through sophisticated and circuitous knapping methods; and, finally, it can be assumed in the case of the colonization of new worlds, as these all require attention-retention, long-term planning, and language-based reasoning abilities.

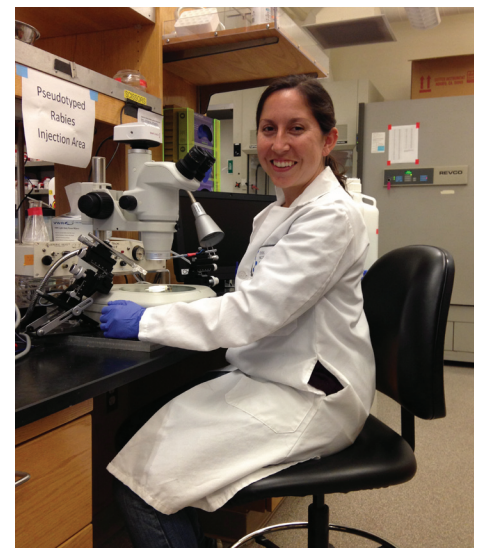


Corinna Most studying the social skills of baboons in Africa.

Heidi Sharipov Neurosciences

Dr. Michael Hammer (University of Arizona) remarked that when the “Out of Africa” theory began to gain popularity following a series of mitochondrial DNA (mtDNA) studies in the 1980’s, it sparked debates on the origin of anatomically modern humans (AMH). The primary result of the mtDNA studies was that AMH originated in Africa and completely replaced archaic humans living throughout the Old World with no interbreeding. While a growing body of evidence in the early 2000’s from individual nuclear genes suggested some degree of interbreeding, it was not until the release of the draft genomes of two extinct forms of archaic humans in 2010, Neanderthals and Denisovans, that the strict African replacement model was overturned.

By comparing contemporary African DNA sequence variation, Hammer’s lab uncovered evidence that African populations contain a small proportion of genetic material that introgressed ~35 thousand years ago from an archaic population that split from the ancestors of AMH ~700 thousand years ago. From this type of study, it is clearly no longer a question of whether there was interbreeding between anatomically modern humans and archaic humans, but rather a question of which genes were altered and the role of these alterations. Hammer favors the idea that genetic exchange between divergent lineages may be a common feature of human evolution, and hybridization may have played a key role in the origin of some of our uniquely human traits.



Heidi Sharipov studying the developing visual system of tadpoles.

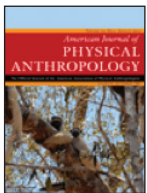
CARTA-Inspired Publications

Transdisciplinary interaction is at the core of CARTA's mission in advancing human origins research. CARTA symposia provide a forum for experts from vastly different fields to share knowledge and work together to spark new research. The following are a selection of publications inspired by interactions amongst CARTA members (**in bold**) and facilitated by CARTA. (Complete list at the CARTA website)



Arbib, M.A., editor. *Language, Music, and the Brain: A Mysterious Relationship*. Cambridge, MA: The MIT Press; 2013. Contributors: **Arbib, M.A.**, **Patel, A.D.**, **Peretz, I.**

This compelling account explains how the human brain evolved to make language possible and how cultural evolution guided the transition to full-fledged languages. It offers insights into the evolutionary importance of the brain's mirror neurons and provides nonspecialist readers with all the necessary background in primatology, neuroscience, and linguistics.



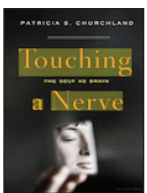
Blevins, J.K., Coxworth, J.E., Herndon, J.G., and **Hawkes, K.** Brief Communication: Adrenal androgens and aging: female chimpanzees (*Pan troglodytes*) compared with women. *Am. J. Phys. Anthropol.* 2013; 151:643-648

Female fertility ends at similar ages in humans and chimpanzees, our closest living cousins. Then ovarian estrogen plummets. Estrogen is crucial for many functions. Yet chimpanzees become decrepit while still cycling - rarely surviving their fertile years - while women remain strong for decades longer. This paper shows that a likely part of the answer to this riddle is the adrenal androgen DHEAS.



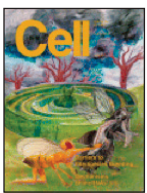
Chukoskie, L. A., et al. including **Sejnowski, T.J.** Learning where to look for a hidden target. *Proc. Natl. Acad. Sci.* 2013; 110 (Suppl. 2):10438-10445.

Survival depends on successfully foraging for food, which has driven evolution. Humans forage not only for food, but also for information. We decide where to look over 170,000 times per day, approximately three times per second. Experience influences our choice of where to look and measuring where we look is a direct way to probe the brain circuits involved in human memory and decision making.



Churchland, P.S. *Touching a Nerve: The Self as Brain*. New York, NY: W.W. Norton and Company; 2013.

A groundbreaking survey of how evolutionary biology and neuroscience, along with psychology and anthropology, have brought us closer to understanding decision-making, morality, the sense of self and consciousness. *Touching a Nerve* interweaves personal stories, fascinating examples, and findings about brain structures, neurochemicals, and genetic influences to give a concrete vision of what the self is and how it arises from the brain.



Cotney, J., et al. including **Rakic, P.**, and **Noonan, J.P.** The evolution of lineage-specific regulatory activities in the human embryonic limb. *Cell.* 2013; 154:185-196.

Uniquely human features in the limbs arise early in development. To identify genetic changes underlying these traits, we profiled active gene regulatory sequences in developing limbs of human, rhesus macaques, and mice. Comparative analyses reveal a fraction of regulatory sequences are active specifically in the human embryonic limb resulting in gain of regulatory activity and increased gene expression.



Crespi, B. Developmental heterochrony and the evolution of autistic perception, cognition and behavior. *BMC Medicine.* 2013; 11:119.

In this study, I showed that the differences between autistic individuals and typically-developing individuals closely paralleled the differences between younger and older typically-developing individuals. These findings suggest that the evolutionary extension of child development period along the human lineage has influenced risk for autism, and the expression of autistic traits.



Crittenden, A.N., Conklin-Brittain, N.L., Zes, D.A., **Schoeninger, M.J.**, and Marlowe, F.W. Juvenile foraging among the Hadza: implications for human life history. *Evolution and Human Behavior.* 2013; 34:229-304.

This paper tests the embodied capital model, which argues that childhood evolved because a long training period is required to become a competent adult. Using data on juvenile foraging among Hadza foragers, we find some support for the embodied capital model, but suggest that increases in foraging efficiency with age may be a byproduct of learning, strength, and/or individual motivation.



Glasser, M.F., et al. including **Preuss, T.M.** Trends and properties of human cerebral cortex: correlations with cortical myelin content. *Neuroimage.* In Press.

Glasser et al. used MRI to measure the myelin content of cortical gray matter in large samples of humans, chimpanzees, and macaque, yielding accurate and reliable cortical maps. The results indicate that in human evolution, higher-order association cortex expanded relative to sensory and motor cortex. This is consistent with classical views that have recently been questioned.



Marchetto, M.C., et al. including **Muotri, A.R.**, **Gage, F.H.** Differential LINE-1 retrotransposition in pluripotent stem cells between humans and other great apes. *Nature.* In Press.

Taking advantage of reprogramming technology, we have generated pluripotent stem cells (iPSCs) from chimpanzees and bonobos. When comparing human, chimpanzee and bonobo iPSCs, we found differences in regulators of the transposon L1 (a jumping gene) and in L1 mobility. Differences in L1 mobility may have differentially shaped the genomes of great apes and could have ongoing adaptive significance.



Prado-Martinez, J., et al. including **Gagneux, P.**, **Tishkoff, S.A.**, **Ryder, O.A.**, **Navarro, A.**, **Bustamante, C.D.**, **Hammer, M.F.**, and **Eichler, E.E.** Great ape genetic diversity and population history. *Nature.* 2013; 499:471-475.

The genetic diversification of modern humans has been intensively studied. However, the patterns of migration, dispersal, population contraction and expansion of the great apes has been less clear. Whole genome sequences of 79 great apes, studied in a collaboration that included seven CARTA members, sheds new light on genetic variation and population diversification of our closest relatives.

CARTA-Inspired Publications, Continued



Sterner, K.N., et al. including **Sherwood, C.C., Hof, P.R., Grossman, L.I., Goodman, M.** Characterization of human cortical gene expression in relation to glucose utilization. *Am. J. Hum. Biol.* 2013; 25:418-430.

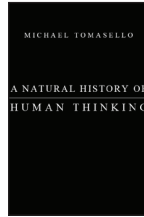
Human brain development follows a unique pattern of prolonged postnatal growth and reorganization.

Although physiological metrics like a postnatal peak in glucose utilization are known, underlying molecular processes are poorly characterized. We determined gene expression trajectories in human cortical samples from infancy to adulthood and examined the evolutionary history of genes differentially expressed as a function of age.



Striedter, G.F., **Avise, J.C., and Ayala, F.J.,** editors. *In the Light of Evolution: Volume VI: Brain and Behavior.* Washington D.C.: The National Academies Press; 2013. Contributors: **Krubitzer, L.A., Kaas, J.H., Preuss, T.M.**

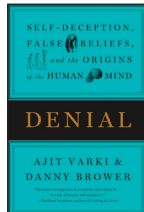
The methods relevant to brain evolution have expanded tremendously. Intracellular and extracellular recording techniques, immunohistochemistry, axon tracing, and excitotoxic brain lesions have revolutionized the understanding of brain structure and function. Neuroscience has also been transformed by molecular methods. The 17 chapters represent a broad assortment of contemporary research in evolutionary neurobiology.



Tomasello, M. *A Natural History of Human Thinking.* Cambridge, MA: Harvard University Press; In Press.

Tomasello argues that the key to human's cognitive uniqueness is cooperative social interaction. To negotiate a more cooperative lifestyle, early humans had to coordinate their actions and communicate their thoughts with collaborative partners.

Tomasello's "shared intentionality hypothesis" captures how these more socially complex forms of life led to more conceptually complex forms of thinking.



Varki, A., Brower, D. *Denial: Self-Deception, False Beliefs, and the Origins of the Human Mind.* New York, NY: Twelve, Hatchet Books; 2013.

This "Mind over Reality" theory runs counter to common assumptions about why the human mind evolved as it did, leaving other intelligent species far behind. Establishing the uniquely human ability for a "full theory of mind" or "multilevel intentionality"

required that we deny unpleasant realities such as mortality. We are the only species that successfully breached this "psychological evolutionary barrier," leaving us with positive and negative consequences of both Reality Denial and Theory of Mind.

CARTA Symposia Schedule

Mind Reading: Human Origins and Theory of Mind
October 18, 2013 • Salk Institute

Birth to Grandmotherhood: Childrearing in Human Evolution
February 21, 2014 • UC San Diego

Male Aggression and Violence in Human Evolution
May 16, 2014 • Salk Institute

Domestication and Human Evolution
October 10, 2014 • Salk Institute

CARTA on the Web



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Want to rewatch a CARTA symposium? Our symposia, including "**Behaviorally Modern Humans: The Origin of Us**" (May 2013), are available at these websites.

What is CARTA?

The UC San Diego/Salk Institute Center for Academic Research and Training in Anthropogeny (CARTA) is dedicated to answering the age old questions "where did we come from?" and "how did we get here?" As CARTA explores the origins of humanity, we are not only answering philosophical and existential questions, but also addressing very practical issues such as human nutrition, medicine, mental disease, the organization of society, the upbringing of our young, and the interactions of humans with one another and with our environment. CARTA organizes symposia aimed at exploring key issues surrounding the pursuit of understanding our origins.

For more information, please visit <http://carta.anthropogeny.org>

Support CARTA

Your donation to CARTA has the power to impact and transform the study of anthropogeny and the understanding of human origins. There are three ways to donate to CARTA:

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