## Constructing a Human World Fit for Nature

*Organized by: Mimi E. Lam, University of British Columbia, Vancouver*

Today, the human built environment dominates global natural ecology, which human culture has imperilled. This makes it timely to investigate the evolutionary processes that enabled ancestral hominins to adapt so successfully to diverse ecological niches and modern humans to transform local ecosystems and the global climate so dramatically. Humans are increasingly interconnected, through science, technology, trade, transportation, and communication, but what were the evolutionary building blocks of these global networks? A multinational cadre of scholars re-examines human evolution through the interdisciplinary lens of niche construction theory, which argues that all organisms both adapt to and modify their local environments. Within this framework, human innovations are not only adaptations to, but also sources of environmental challenges. Human artefacts and language perpetuate cultural innovations and knowledge to construct new human niches, embedded within a co-evolutionary process of eco-cultural niche construction. The varying time scales of the ecological and cultural processes of human niche construction pose an evolutionary conundrum, as modern society jeopardizes the life-support systems of Earth by irreversibly altering local and global ecology. By elucidating the co-evolution of humans and nature, this symposium stimulates a fresh perspective in natural resource management and policy that may guide us to engineer a future that conserves, not overexploits nature.

### THE EVOLUTION OF THE SUPER-CONSTRUCTORS

*Kevin Laland, University of St. Andrews, Scotland*

Niche construction is the process through which organisms modify their local environments, thereby modifying natural selection and influencing their own evolution. Niche construction theory (NCT) is an emerging feature of modern evolutionary biology, and provides compelling evidence that niche construction is evolutionarily and ecologically consequential. Nowhere is this more true than for humans, who can aptly be caste as 'super-constructors'. In this talk I will describe how NCT sheds light on human evolution, and helps to explain our extraordinary capability to modify ecological and social environments.

### THE FIRST COMMODITY: HANDAXES

*Mimi E. Lam, University of British Columbia, Vancouver*

I argue that the ability to build portable, durable artefacts may trace the evolution of human cognition. Hominins evolved a complex suite of stone tools, which reflected both emerging individual cognition and embodied knowledge. The manufacture of robust, standardized artefacts may have enabled their trade and imbued them, over time, with cultural meaning within hominin social groups. Here, the longevity, ubiquity, durability, and stability in design of Acheulean handaxes is explained by viewing handaxe construction in three temporal phases, co-evolving with the human niche: first, as iconic multipurpose functional tools, fashioned by ancestral hominins; second, as standard indexical commodities exchanged in social relationships, perhaps as a paleocurrency among pre-linguistic hominins; and third, as symbolic of cultural power, carried and exchanged as gifts by modern humans within socially constructed niches, now filled with shared meanings and language

### THE SOCIALLY CONSTRUCTED ARTIFICIAL HOMINID NICHE: PRELINGUISTIC SYMBOLIC COMMUNICATION

*Terrence W. Deacon, University of California, Berkeley*

### HOW CULTURE DROVE HUMAN EVOLUTION

*Joe Henrich, University of British Columbia, Vancouver, BC*

### GENERAL PATTERNS OF NICHE CONSTRUCTION IN SMALL-SCALE SOCIETIES

*Bruce D. Smith, Smithsonian Institution, Washington, DC*

The domestication of plants and animals by early human societies will be examined to reveal general patterns of niche construction in small-scale societies. The keys to successful ecosystem engineering will be identified and linked to the origins of human dominance of Earth's ecosystems. Ultimate niche constructors with a rich repertoire of ecosystem skills, humans are being challenged now to apply those skills to reverse and reduce human modification of environments.

### NATURE, NURTURE, AND HUMANITY'S SELF-DESTRUCTIVE NICHE

*William Rees, University of British Columbia, Vancouver, BC*

## Gesture, Language, and Performance: Aspects of Embodiment

*Organized by: Philip Rubin, Haskins Laboratories, New Haven, CT*

Communication, language, performance, and cognition are all shaped in varying ways by our embodiment (our physicality, including brain and body) and our *embeddedness* (our place in the world: physical, social, and cultural). The real-time production of spoken and signed language involves the dynamic control of speech articulators, limbs, face, and body, and the coordination of movement and gesture, by and between individuals. Increases in computing power and the recent emergence of ubiquitous and flexible sensing and measurement technologies, from inexpensive digital video and other devices to higher end tools, are beginning to make it possible to capture these complex activities more easily and in greater detail than ever before. We are on the cusp of a revolution in sign, gesture, and interactive communication studies. New computational and statistical tools and visualization techniques are also helping us to quantify and characterize these behaviors and, in certain instances, use them to control and synthesize speech, gesture, and musical performance. This symposium brings together experts spanning linguistics, computer science, engineering, and psychology to describe new developments in related areas of inquiry. These include coordination and synchrony during spoken and signed language, gestural control of musical performance, physiologically and acoustically realistic articulatory speech synthesis, and cognitive and linguistic development.

### TALKING WITH YOUR MOUTH FULL: PERFORMING WITH A GESTURE-TO-VOICE SYNTHESIZER

*Sidney Fels, University of British Columbia, Vancouver*

We create DIgital Ventriloquized Actors (DIVAs) that use hand gestures to synthesize speech and song by means of an intermediate conversion of these gestures to articulatory parameters of a voice synthesizer. This requires overcoming technical challenges related to tracking gestures, synthesis quality, and the complex mapping between performance and meaningful, expressive vocal sounds that are easy to learn. We discuss these components contrasting a frequency-based and an articulatory based approach for speech synthesis. The relationship between gesture and voice production embodied in a new type of musical instrument provides a rich means for human expression. We show the latest performance work composed using these DIVAs.

### CAPTURING THE STRUCTURE OF AMERICAN SIGN LANGUAGE

*Martha Tyrone, Long Island University, Brooklyn, NY*

American Sign Language (ASL) is a natural, signed language used by Deaf people in the United States and Canada. (The term 'Deaf' refers to the community of ASL users rather than to clinical hearing loss.) Unlike spoken languages, signed languages use the hands and arms as primary articulators, and signs are perceived visually rather than auditorily. While researchers have been studying the linguistic structure of ASL for several decades, investigation of the physical/articulatory structure of the language has been extremely limited. This study examines ASL using the theoretical framework of articulatory phonology, which proposes that the basic units of speech are articulatory gestures. Thus, according to this theory, the articulatory and linguistic structure of spoken language are inter-related. We hypothesize that articulatory gestures are also the structural primitives of signed language, and we are investigating what the gestures are and how they are timed. For this study, sign production data were collected using an optical motion capture system that tracked the positions of the arms, head, and body over time as Deaf signers produced ASL phrases. The signers were asked to produce specific target signs occurring in various phrase positions. The target signs included movements either toward or away from the body, allowing us to compare superficially-similar but linguistically-distinct movement phases: as the arm moves toward a location on the body, spends some time at that location, and then moves away from the body. Our findings suggest that signs, like spoken words, are lengthened at phrase boundaries in a manner consistent with the predictions of a task-dynamic model of prosodically induced slowing. In the long run, these findings could assist with the automatic parsing of American Sign Language.

## COORDINATION: THE PLAYTHING OF EXPRESSIVE PERFORMANCE

*Eric Vatikiotis-Bateson, University of British Columbia, Vancouver*

Spoken communication and musical performance are arguably our most highly skilled activities. In order to analyze speech and music behaviorally, we must find tractable ways to associate complex signal arrays with events of interest. Unfortunately, both sides of this association are problematic. Signals may occur simultaneously within and across multiple channels and modalities, at multiple physical locations, and with the potential for signal correspondence at multiple levels of spatial and temporal coordination — that is, patterns within patterns. Determining what events to measure is limited by technology and by a predisposition to seek familiar structures that may not accommodate the context-specific event structures that emerge in ephemeral behavior. The problem is that if, as we believe, communicative expression is predominately context-dependent, then identifying emergent events is of fundamental importance. In this talk, we describe an approach to the measurement and analysis of expressive language and musical performance that allows both emergent and familiar events to be quantified in the instantaneous correlation patterns between signals. Our method demonstrates that spatial and temporal coordination within and between performing individuals is ubiquitous and can be accurately assessed so long as temporal fluctuations in the pattern structure are incorporated into the analysis. We also demonstrate the value of *optical flow analysis* as a non-invasive and labor-saving means of recovering two-dimensional motion from video recordings. What was previously thought to be a crude method of motion capture, when pooled for defined *regions of interest*, provides sensitive measures of performance behavior. We exemplify the motion capture and correlation analysis techniques using conversational data from: English, Shona (Zimbabwe), and Plains Cree (Western Canada); the integration of posture, respiration, and vocalization in speech and song; and the expressive coordination between pianist and vocalist in *Lieder/Art Song*.

## Neuroscience and Criminal Justice in the 21st Century: A Cross-Country View

*Organized by: Judy Illes, University of British Columbia, Vancouver; Michael J. Zigmond, University of Pittsburgh, PA*

**Although our views and opinions about criminal behavior are guided by traditional concepts of crime and punishment, cutting-edge studies of brain structure and function have inevitably focused attention on our criminal justice system. For example, differences in brain structure can cause aberrations in behavior, including criminal behavior. This session examines the ways in which the findings from bench neuroscientists, using ever-more sophisticated techniques such as neuroimaging, become implicated in criminal justice proceedings and how views of who is guilty and what remedies should follow are influenced by new knowledge of the brain. Human memory, one of the most important elements of a criminal proceeding, will be examined by a scientist and a judge, who will discuss the implications of our broadening understanding of the science of human memory for how we view the reliability of eyewitness testimony and ultimately its influence on who is found guilty and who is not. Changes in views of guilt, based on emerging findings in neuroscience, may also change notions about human responsibility, including responsibility for potentially criminal acts. To complicate matters, views of guilt and innocence as well as responsibility and agency are also influenced by how the public views this developing science: views that will partly be driven by the media and that will ultimately have a direct effect on decisions made by judges and juries.**

## TO THE BEST OF MY RECOLLECTION: THE COGNITIVE NEUROSCIENCE OF TRUE AND FALSE MEMORY

*Craig Stark, University of California, Irvine*

Memory is not a picture-perfect recollection of all details previously experienced. Instead, it is a reconstruction based on an array of information, from experienced details to imagined reactions and current constraints of mood and task expectations. In addition to misinformation from outside influences, normal memory processes themselves can affect how accurate memory recollection can be — processes that are affected by aging, neurologic and psychiatric conditions. I will discuss these effects and how they relate to eyewitness testimony in the courtroom.

## THE BRAIN AND THE BENCH: EYEWITNESS TESTIMONY, POLICE LINE-UPS, AND CRIMINAL TRIALS

*Ronald Reinstein, Superior Court of Arizona (retired), Scottsdale*

"I'll never forget the face of the man who held a gun to my face." According to several studies, of the over 270 people who have been exonerated from their criminal convictions with the use of DNA evidence, over 75% have involved mistaken eyewitness identifications. Being a victim or a witness of a violent criminal act can impact the witness' memory. Traditionally, many justice system participants have believed the victim/witness memory is enhanced when faced with a traumatic episode such as a rape, armed robbery, or homicide, but years of social science research has demonstrated that eyewitness identification is not always reliable and that issues such as weapons focus, cross-racial identification, and face memory can impact crime witnesses. Several states have implemented significant changes, either by case law or legislatively, to improve the method by which law enforcement agencies conduct photographic lineups. A recent National Institute of Justice study reports that there are ways to improve eyewitness reliability through the use of "double blind", sequential photo lineups. Some law enforcement agencies have embraced the changes, while others have embraced them. The New Jersey Supreme Court recently set new rules to address the weaknesses. They found in New Jersey courts based on a "troubling lack of reliability" of eyewitness identification. This session will explore what courts and other justice system participants can do to improve eyewitness reliability, including lineup procedures, jury instructions, and the use of expert witnesses. This work is essential to promote fairness and justice in criminal trials.

## FROM RESEARCH TO EVIDENCE: BEHAVIORAL SCIENCES IN THE COURTROOM

*Nita Farahany, Vanderbilt University, Nashville, TN*

Recent scientific progress has dramatically advanced our understanding of the biological, neurological and environmental contributions to normal and deviant human behavior. Behavioral scientists have moved beyond purely descriptive scientific accounts to predictive ones by linking genetic and neurological variations to behavioral variations in the population. Growing societal and academic interest in the intersection between behavioral genetics, neuroscience and criminal law is evident by the frequency with which major mainstream and academic publications feature articles on this topic. Yet, popular and academic studies on the intersection of biosciences and the law have been based on ad hoc reporting and analysis, rather than a systemic analysis of its use. This presentation summarizes the first wide-scale and comprehensive empirical study on the use of these biosciences in the U.S. criminal justice system. Based on over 700 relevant legal opinions published by Westlaw between 2005–2009, this study captures and categorizes every mention of behavioral genetics or neuroscience introduced on behalf of a criminal defendant during that time. The study results confirm some ad hoc hypotheses in the field to date, such as the frequency with which certain claims are raised, such as mitigation. But the study also reveals as-of-yet discussed applications of biosciences in criminal law. These novel claims may have greater success and normative justification than the previously assumed and discussed uses of biosciences in U.S. criminal law.

## THE END OF CRIMINAL RESPONSIBILITY?

*Peter McKnight, The Vancouver Sun, BC, Canada*

Many commentators have suggested that advances in neuroscience present a challenge to traditional conceptions of free will and criminal responsibility, and call into question the efficacy and defensibility of punishment. Drawing on work in both philosophy of law and philosophy of science, this talk will consider how neuroscience contributes to our evolving conception of criminal responsibility and how it might alter our attitudes toward punishment.

## NEUROTECHNOLOGY, LAW, AND THE MEDIA

*Timothy Caulfield, Health Law Institute, Edmonton, AB, Canada*

In the past decade, neuroscience has received a significant amount of attention in popular press, including news stories about the ability to use neuroscanning technologies to read minds and identify individuals with a propensity toward criminal behaviour. This presentation will explore the nature of the popular culture representations of neuroscience and the potential impact of these representations on both public perceptions and the legal applications of emerging neuroscience technologies.