KEYNOTE SPEAKERS

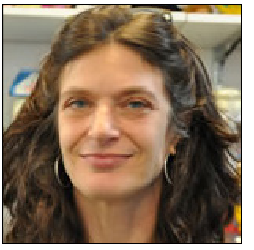
Daniel Wolpert

University of Cambridge, United Kingdom

Daniel Wolpert read medical sciences at Cambridge and clinical medicine at Oxford. He completed a PhD in the Physiology Department at Oxford and was a postdoctoral fellow at MIT, before moving to the Institute of Neurology, UCL. In 2005 he took up the post of Professor of Engineering at the University of Cambridge and was made a Fellow of Trinity College. He was elected a Fellow of the Academy of Medical Sciences in 2004 and was awarded the Royal Society Francis Crick Prize Lecture (2005), the Minerva Foundation Golden Brain Award (2010) and gave the Fred Kavli Distinguished International Scientist Lecture at the Society for Neuroscience (2009). In 2012 he was elected a Fellow of the Royal Society (FRS) and made a Wellcome Trust Senior Investigator. In 2013 he was appointed to the Royal Society Noreen Murray Research Professorship in Neurobiology. His research interests are computational and experimental approaches to human sensorimotor control (***www.wolpertlab.com***).

Probabilistic models of sensorimotor control and decision making

The effortless ease with which humans move our arms, our eyes, even our lips when we speak masks the true complexity of the control processes involved. This is evident when we try to build machines to perform human control tasks. I will review our work on how humans learn to make skilled movements covering probabilistic models of learning, including Bayesian and structural learning as well as the role of context in activating motor memories. I will also review our work showing the intimate interactions between decision making and sensorimotor control processes. This includes the bidirectional flow of information between elements of decision formations such as accumulated evidence and motor processes such as reflex gains. Taken together these studies show that probabilistic models play a fundamental role in human sensorimotor control.



Karen Adolph

Infant Action Lab, USA

Karen Adolph is Professor of Psychology and Neuroscience at New York University. She received her B.A. from Sarah Lawrence College, her Ph.D. from Emory University, and completed a postdoctoral fellowship at the Albert Einstein College of Medicine. Adolph leads the Databrary.org project to enable video data sharing among developmental scientists. She is a Fellow of APA and APS and President of the International Society for Infant Studies. She received a Cattell Sabbatical Award, the APF Fantz Memorial Award, the APA Boyd McCandless Award, the ISIS Young Investigator Award, FIRST and MERIT awards from NICHD, and four teaching awards from NYU. She chaired the NIH study section on Motor Function and Speech Rehabilitation and is on the Advisory Board of the McDonnell Foundation and the editorial board of Developmental Psychobiology. Adolph's research examines effects of body growth, exploratory activity, environmental and social supports, and culture on perceptual-motor learning and development.

How Infants Learn To Walk (And How They Don't)

Typically, researchers represent the development of locomotion as a series of increasingly upright milestones and study locomotor development in terms of improvements in gait as infants crawl or walk on a treadmill or along a straight uniform path. However, the milestone and gait approaches to locomotor development have important empirical and conceptual flaws. I suggest several alternative ways to study how infants learn to walk: (1) Observing the development of natural locomotion in the everyday environment will provide insights into the phenomenon researchers ostensibly wish to explain and facilitate. (2) Examination of effects of functional changes in the body will inform on how infants learn to walk in the context of ongoing physical development. (3) Focus on infants' use of perceptual and social information will reveal how infants guide locomotion through a cluttered natural environment. (4) Assessment of the developmental sequelae of independent mobility will situate locomotion in a larger developmental context. (5) Inclusion of a broader sample of infants will reflect how cultural differences in childrearing practices affect the development of locomotion. (6) Sharing videos and other forms of raw data will lead to greater transparency, allow for data reuse, and facilitate integrative analyses.

Amy Bastian

Kennedy Krieger Institute, USA

Dr. Amy Bastian is a neuroscientist and physical therapist who studies the neural control of human movement. She has a special interest in cerebellar motor disorders, stroke, motor learning, and walking control. She is the Director of the Motion Analysis Laboratory at the Kennedy Krieger Institute and Professor of Neuroscience at Johns Hopkins. Her research uses computerized movement tracking techniques and novel devices to control walking and reaching movements. She studies how humans with and without neurological damage control movement and learn new patterns.

Learning and relearning locomotor patterns

Human locomotor learning depends on a suite of brain mechanisms that are driven by different signals and operate on timescales ranging from minutes to years. Understanding these processes requires identifying how new walking patterns are normally acquired, retained, and generalized, as well as the effects of distinct brain lesions. The lecture will focus on normal and abnormal locomotor learning, and how we can use this information to improve rehabilitation for individuals with neurological damage.

James Lackner

Brandeis University, USA

James R. Lackner received his undergraduate and graduate training at the Massachusetts Institute of Technology. He is currently Director of the Ashton Graybiel Spatial Orientation Laboratory and Riklis Professor of Physiology at Brandeis University. His research interests concern human movement control and orientation in unusual force conditions, including weightless, high force, and rotating artificial gravity environments. Experiments in these different contexts have led to insights into how our bodies are dynamically tuned and adapted to the background acceleration of Earth gravity. A major recent interest has been adaptation of postural control to rotating environments and its implications for understanding mechanisms of fall recovery after perturbations of stance. This work is leading to development of non-parallel 2-leg models of balance control as well as haptic cueing techniques for stabilizing posture and enhancing postural recovery during falls. The role of the otolith organs in modulating the integration of semicircular signals during dynamic balancing is an ongoing research theme as well.

Experiments in Unusual Force Environments Unmask Our Postural Adaptations to Earth Gravity

This presentation will describe how experiments conducted on orientation and postural control in non-1 g and rotating environments provide insights into the dynamic sensory-motor adaptations of our bodies to the terrestrial force background of Earth gravity. We are not consciously aware of most of these adaptations because the central nervous system carries them out automatically. We become aware of them during exposure to non-1g accelerations because errors in the execution and appreciation of our movements result.

Lena Ting

Emory University, USA

Dr. Ting is a Professor in the W.H. Coulter Department of Biomedical Engineering at Emory University and Georgia Institute of Technology. She received a B.S. in Mechanical Engineering at the University of California at Berkeley, an M.S.E. in Biomechanical Engineering and Ph.D. in Mechanical Engineering from Stanford University. She received postdoctoral training in neurophysiology at the University of Paris V, and Oregon Health and Sciences University. Her research in neuromechanics focuses on the sensorimotor interactions between brain, body, and environment at the level of muscular coordination during balance and gait in humans and animals using methods from neurophysiology, rehabilitation, robotics, and biomechanics. She uses experimental and computational methods to understand the neural basis of the structure and variability of sensorimotor patterns and has recently developed collaborations to use such methods to understand of gait and balance deficits and mechanisms of rehabilitation in stroke, spinal cord injury, Parkinson's disease, and lower limb loss."

Neuromechanics of gait and balance rehabilitation

Understanding how neural and biomechanical interactions shape the way we move is critical in the study of whole body tasks such as gait and balance. Neuromechanical interactions define whether and how neural signals can influence motor function as well as how biomechanics may affect the structure of neuromotor organization. As there are no one-to-one relationships between neural signals and biomechanical variables, variations in neuromotor signals within and across individuals must be carefully interpreted. Depending on the context, variations in neuromotor signals can have no effect, or conversely, play a critical role in motor function. Using a neuromechanical approach to define motor deficits in neurological disorders may be particularly important for developing novel rehabilitation paradigms using adjuvant therapies, which enhance neural plasticity in combination with training to improve specific motor functions. I will give examples of novel gait and balance rehabilitation paradigms in individuals with stroke, spinal cord injury, and Parkinson's disease. Ultimately, neuromechanical approaches may help refine clinical testing to provide better specificity for diagnostic criteria and rehabilitation treatments, develop predictive models to identify individuals and subpopulations that stand to benefit the most from a given treatment, and facilitate the identification of physiological mechanisms of motor deficit and recovery.