THE Flexner DISCOVERY LECTURE SERIES

Upcoming Discovery Lecture:

PETER AGRE, M.D.

Bloomberg Distinguished Professor and
Director of Johns Hopkins Malaria Research Institute

Jan. 21, 2016
208 Light Hall / 4:00 P.M.

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DORA ANGELAKI, PH.D.

A COMPUTATIONAL PERSPECTIVE ON AUTISM

JANUARY 14, 2016
4:00 P.M.
208 LIGHT HALL

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VANDERBILT BRAIN INSTITUTE

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A COMPUTATIONAL PERSPECTIVE ON AUTISM

DORA ANGELAKI, PH.D.

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Autism spectrum disorder (ASD) is a neurodevelopmental disorder that manifests as a heterogeneous set of social, cognitive, motor, and perceptual symptoms, including superior low-level task performance and inferior complex-task performance. By manipulating task difficulty independently of visual stimulus noise, we provide support for the hypothesis that heightened sensitivity to noise, rather than integration deficits, may characterize ASD. Strikingly, individuals with ASD demonstrated intact multisensory (visual-vestibular and visual-auditory) spatial integration, even in the presence of noise. Additionally, when vestibular motion was paired with pure visual noise, individuals with ASD demonstrated a different strategy than controls, marked by reduced flexibility. This result could be simulated by less reliable and inflexible experience-dependent (Bayesian) priors in ASD.

We propose that the neural basis of behavioral changes in ASD reflect alterations in nonlinear, canonical computations occurring throughout the brain. One such computation, called divisive normalization, balances a neuron's net excitation with inhibition reflecting the overall activity of the neuronal population. Comparison between neural network simulations and the disorder's behavioral consequences, we establish a bridge between an imbalance in excitation/inhibition and behavioral data on autism. These analyses show how a computational framework can provide insights into the neural basis of disease and facilitate the generation of falsifiable hypotheses. A computational perspective on autism may help resolve debates within the field and aid in identifying physiological pathways to target in the treatment of the disorder.

Dora Angelaki, Ph.D., is Wilhelmina Robertson Professor and Chair of the Department of Neuroscience at Baylor College of Medicine, and Professor in the Department of Psychology and Electrical and Computer Engineering at Rice University. She holds a PhD in Biomedical Engineering and a Masters of Biomedical Engineering from the University of Minnesota, and a BSc in Electrical Engineering from the National Technical University of Athens in Greece. Her key professional interests are navigation circuits, multisensory integration and computational neuroscience. The tools used involve both computational and experimental approaches, including behavioral analyses, single unit recording and microsimulation/inactivation of different brain regions of macaque monkeys in the brainstem, cerebellum, thalamus and the cortex, as well as in mouse model. Her research focuses on understanding how multisensory information flows between subcortical and cortical brain areas, as well as the spatial navigation, decision-making and episodic memory circuits, and how internal states modulate this information flow. Dr. Dora Angelaki is Member of the National Academy of Sciences, American Academy of Arts and Sciences, and International Neuropsychological Society. She serves on a multitude of national and international advisory boards and committees.