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Host-microbe Interactions Regulating Synaptic Plasticity and Behavior

Dr. Shelly Buffington graduated Summa cum laude from the University of Arkansas with a Bachelor of Science in biophysical chemistry with minor emphasis in biology in 2007. She went onto train in neuroscience with Dr. Matthew Rasband, Professor of Neuroscience at Baylor College of Medicine, earning her Ph.D. from Baylor College of Medicine in 2012. Dr. Buffington's graduate research on the structure and function of electrogenic domains in myelinated axons yielded the first evidence of plasticity of the axon initial segment (AIS) in a mouse model of a neurodevelopmental disorder and identified the mechanism by which sodium channel auxiliary subunits are recruited to the AIS and nodes of Ranvier. Dr. Buffington performed her postdoctoral studies with Dr. Mauro Costa-Mattioli, Professor of Neuroscience at Baylor College of Medicine. Her early postdoctoral research on translational control mechanisms regulating synaptic plasticity and behavior identified the translational control program underlying metabotropic glutamate receptor-mediated long-term depression in hippocampal neurons and revealed that local phosphorylation of eukaryotic initiation factor 2-alpha (eIF2□) acts as a bidirectional switch regulating whether hippocampal synapses undergo LTP or LTD. In a landmark paper from Dr. Costa-Mattioli's lab, she and her colleagues demonstrated that a maternal high-fat diet induces long-term, functional changes in the offspring gut microbiome that are causally related to synaptic plasticity and autism-like social deficits in the offspring. Using metagenomic whole genome shotgun sequencing, Dr. Buffington and her colleagues identified a bacterial species, Lactobacillus reuteri, that is eliminated by maternal high-fat diet but, once restored, rescues offspring social behavior and the underlying molecular and neurophysiological deficiencies. Subsequent studies from the Costa-Mattioli lab and others have revealed that treatment with Lactobacillus reuteri can rescue behavioral deficits in multiple mouse models of autism, including environmental, idiopathic, and genetic models. Her work has been featured in both scientific and popular press outlets, including Science, Nature, The Economist, and, most recently, The New York Times. In 2019, she joined the faculty of the Department of Neuroscience, Cell Biology, and Anatomy at the University of Texas Medical Branch at Galveston where she leads a research group investigating host-microbe interactions regulating synaptic plasticity and behavior.

Abstract: It is becoming increasingly evident that behavioral phenotypes are determined not only by the host genome, but by the hologenome, the combination of host and microbial genes. Emerging data from our lab and others suggest that gut microbiota are key regulators of both normal nervous system physiology and disease states. The goal of our work is to establish a molecular-to-systems level understanding of how gut microbiota contribute to host brain development, function, and behavior and how dysbiosis–a pathological imbalance of microbial ecology–of the gut microbiome contributes to neurodysfunction. We are particularly interested in how dysbiosis of the maternal gut microbiome during pregnancy impacts fetal brain development and, ultimately, long-term mental health outcomes in children. In the lab, we combine metagenomics and metabolomics with microbiology, biochemistry, electrophysiology, and behavioral analysis to determine the mechanisms by which gut microbiota impact host neurophysiology and behavior. In this talk, I will discuss recent work in which we identified a bacterial species, Limosilactobacillus reuteri, which rescues social dysfunction and related deficits in social reward circuit plasticity in mouse models for autism spectrum disorder of diverse etiology, including genetic, environmental, and idiopathic models. Together with data from ongoing studies, these findings provide key insight into the underlying mechanisms by which gut microbiota influence host behavior. Furthermore, they underscore the potential for gut microbiota as both an innovative therapeutic and therapeutic target for the treatment and prevention of mental health disorders.