

SLHS DISTINGUISHED ALUMNI

# NEURAL SYSTEMS UNDERLYING SPEECH LEARNING

## Bharath Chandrasekaran, PhD

### Abstract:

My research program employs a systems neuroscience approach to investigate the computations, maturational constraints, and plasticity underlying auditory and speech categorization. Speech signals are multidimensional, acoustically variable, and temporally ephemeral. A significant computational challenge in speech perception, and more broadly in audition, is categorization – the task of mapping continuous, multidimensional, and variable acoustic signals into discrete behavioral equivalence classes. Despite the complexity of this computational challenge, native speech perception is rapid and automatic. In contrast, learning novel speech categories is effortful and is considered a challenging computational task for the mature brain.

In this presentation, I aim to elucidate the mechanisms underlying how novel speech categories are acquired and represented in the mature brain. I will discuss the neurobiology of two complementary auditory corticostriatal streams involved in sound-to-rule and sound-to-reward mapping. Through a series of experiments using multimodal neuroimaging, behavioral, and computational modeling approaches, I will systematically test the DLS model. I will demonstrate that:

1. Neural representations of novel speech categories can emerge in the superior temporal gyrus within a few hundred training trials of sound-to-category training.
2. Pre-attentive signal reconstruction in the subcortical auditory system is also subject to behaviorally-relevant experience-dependent plasticity.
3. The robustness of structural and functional connectivity within the sound-to-reward corticostriatal stream can predict learning outcomes.

Finally, I will discuss ongoing experiments that leverage the neurobiology of the dual corticostriatal streams to design optimal behavioral training and targeted neuromodulation interventions.



### Speaker Bio:

Dr. Bharath Chandrasekaran is the Ralph and Jean Sundin Professor and Chair of the Roxelyn and Richard Pepper Department of Communication Sciences and Disorders at Northwestern University. Prior to Northwestern, he served as a Professor and Vice Chair of Research in the Department of Communication Sciences and Disorders. He earned his Ph.D. in Integrative Neuroscience from Purdue University in 2008, completed a postdoctoral fellowship at Northwestern University before joining the University of Texas at Austin in 2010. He is the recipient of Regents' Outstanding Teaching Award in 2014, the Editor's award for best research article in the *Journal of Speech, Language, and Hearing Research*, the *Psychonomics* Early Career award in 2016, and the *Society for Neurobiology of Language* Early Career Award in 2018, and the Fellowship of the American Speech-Language Hearing Association in 2022. Dr. Chandrasekaran has served as the Editor-in-Chief of the *Journal of Speech, Language, and Hearing Research (Speech)*. Dr. Chandrasekaran's research examines the neurobiological computations that underlie human communication and learning, using an interdisciplinary, computational, and lifespan approach. His laboratory is currently supported by funding from the National Institutes of Health and National Science Foundation.

Thursday, November 2, 2023  
5:00-6:00 PM in LYLE 1160