Detecting Errors and Learning from Mistakes
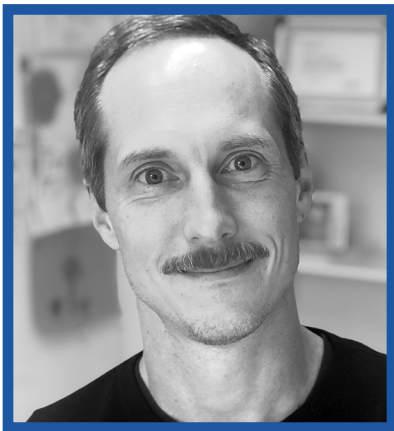
January 7

Tuesday, 12:30 pm

**Billings Building—Rosedale Room**

SPEAKER:

David Schneider, PhD
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Host: Edmund Hollis II, PhD

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Abstract

Identifying mistakes is important for improving performance during acoustic behaviors like speech and music. Although hearing is instrumental for monitoring and adapting behaviors like these, the neural circuits that integrate motor, acoustic, and intention-related signals to detect errors and guide learning in mammals remain unidentified. Here, we show that the mouse auditory cortex encodes error- and learning-related signals during a skilled sound-generating behavior, and that acoustic errors adaptively update motor cortical dynamics. We developed a closed-loop, sound-guided behavior that requires mice to use real-time acoustic feedback to guide their ongoing forelimb movements and is auditory cortex dependent. Auditory cortex neurons encode error signals related to distinct behavioral mistakes, and the activity of these neurons predicts both rapid (within-rendition) and longer (across-rendition) changes in behavior. Auditory cortex sends error-related information to the secondary motor cortex (M2), which is also necessary for this acoustic behavior. Pre-motor M2 dynamics encode the specific behavior that a mouse intends to produce, and distinct acoustic errors push dynamics along this "intention" dimension, indicating a learned coordinate transform that translates specific acoustic errors into adaptive changes in behavior. Together, these experiments identify a cortical circuit for detecting errors and learning from mistakes during skilled, sound-generating behavior in mammals.
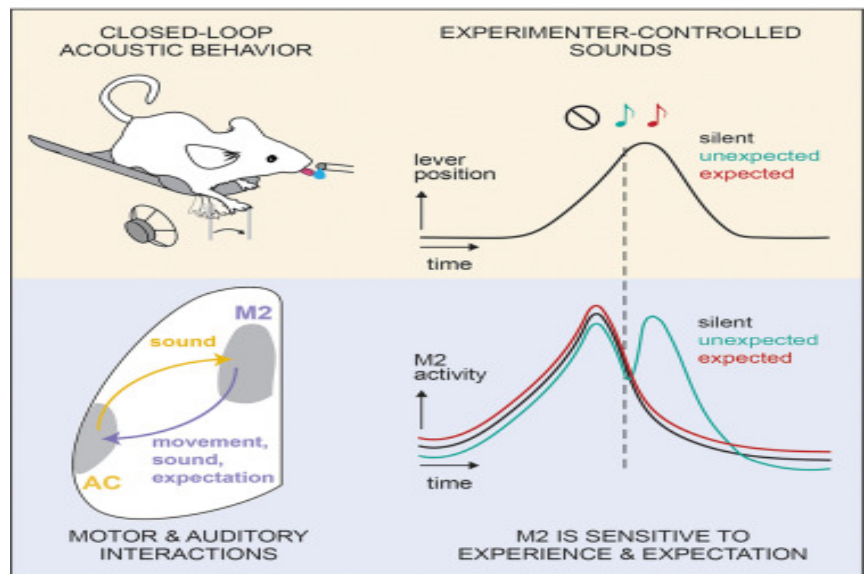
Publications

1. *Learning in a sensory-motor circuit links action to expected outcome.* Zhou W, Schneider DM, bioRxiv, 2024.

2. *Sensation and expectation are embedded in mouse motor cortical activity.* Holey B, Schneider DM, Cell Reports, 2024.

3. *Stimulus-specific prediction error neurons in mouse auditory cortex.* Audette N, Schneider DM, Journal of Neuroscience, 2023.

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