Title: Neural circuits underlying motor planning and movement

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Abstract
The brain integrates past and present information into internal states that influence behavior. A fundamental challenge is to understand how the structure and dynamics of neural circuits support these internal states. We study this question in the neural circuits of motor planning and movement. Unlike simple reflexes, the brain preprograms, or plans, voluntary movements before they are executed. The brain integrates sensory information and goals into persistent motor plans that instruct future movements. Planned movements are faster and more precise than they would have been without planning. Beginning with the work of Tanji and Evarts (70s), it was established from single-unit recordings in primates that some motor cortex neurons display preparatory activity as an animal prepares to make specific movements. This preparatory activity is the neural correlate of a motor plan. Recent advances in neural recording and analytical techniques are beginning to relate these dynamics at the level of neural populations to future movements. However, fundamental mechanistic questions remain unanswered. What is the core neural circuits driving motor planning and how does it support persistent preparatory activity? How is preparatory activity converted into motor command signals to trigger movement? I will describe our effort to delineate when and how activity in specific brain regions drive sensory-guided motor planning in the mouse. I will present evidence that shows the neural circuits underlying motor planning is distributed across multiple brain regions, with specific interactions at the level of cell types. I will discuss some of the experimental challenges faced by studies of multi-regional circuits.