Abstract Information

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Abstract :

The ability of animals to build individual repertoires based on the consequences of their actions is fascinating, and essential for survival. Understanding this process requires mechanistic insight into how self-paced actions are initiated, how they can be selected/initiated again, and how feedback can refine their execution and organization. We use behavioral, genetic, electrophysiological, and optical approaches to gain this mechanistic insight. The combination of these approaches allowed us to uncover that dopaminergic neurons are transiently active before self-paced movement initiation. This activity is not action-specific and modulates both the probability of initiation and the vigor of future movements, but does not affect ongoing movement. Dopamine is supposed to have opposite effects on downstream striatal direct and indirect pathways. Contrary to what is classically postulated, we found that both striatal direct and indirect pathways are active during movement initiation. The activity in both pathways is action-specific and has complementary but different roles in movement, which are enabled by specific basal ganglia output circuits. Input from cortex seems to be critical to organize striatal activity, and cortico-striatal plasticity is necessary to select, reinforce and refine the specific neural and behavioral patterns that lead to desirable outcomes. These data invite new models on the mechanisms underlying self-paced movement initiation, and motor dysfunction in Parkinson?s disease. They also suggest that cortico-basal ganglia circuits play a generic role in learning to reinforce and refine task-relevant neural activity and behavioral patterns.