



## Cortico-subcortical dynamics during complex locomotion

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Locomotion is a fundamental behavior across the animal kingdom. Much research has focused on the role of central pattern generators in locomotion. Yet, the role of supraspinal structures in modulating this behavior, especially during perturbations, remains elusive.

To address this question, we designed a task based on delivering rapid mechanical perturbations to head-fixed mice running on a large spherical treadmill. We applied random, unpredictable perturbations from 12 different positions spanning six locations and two different elevations. This allowed us to elicit a broad range of behavioral responses determined by the direction and duration of the perturbation as well as its timing relative to the mouse' ongoing gait cycle. To study sensorimotor integration along the cortico-basal pathways, we recorded from limb-specific subregions of the sensorimotor cortices, downstream basal ganglia projections, and relay centers in the motor thalamus projecting back to cortex. Simultaneously, we tracked whole-body 3D kinematics to define how neural dynamics within these regions contribute to sensorimotor corrections during locomotion.

Our analysis is focused on understanding how the cortico-basal ganglia pathways translate sensory responses into motor corrections. Our first findings show the presence of rapid perturbation-specific responses in all the examined cortico-thalamo-striatal regions, with similar latencies. However, the perturbations reveal a hierarchy of functional interactions between these areas, which remains obscured during unperturbed running. Our data also indicate a switch in overall neural "state" between and initial unperturbed period and the inter-perturbation running periods despite the similarity of the kinematics between these two epochs. This change, which was most prominent in the motor cortex, is potentially suggestive of a switch in control policy.

**Electrophysiology, Population dynamics, Locomotion**