

Pallidal prototypic neuron and astrocyte activities regulate flexible reward-seeking behaviors

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Behavioral flexibility allows animals to adjust actions to changing environments.

While the basal ganglia are critical for adaptation, the specific role of the external globus pallidus (GPe) is unclear. This study examined the contributions of two major GPe cell types-prototypic neurons projecting to the subthalamic nucleus (Proto^{GPe→STN} neurons) and astrocytes-to behavioral flexibility. Using longitudinal operant conditioning with context reversals, we found that Proto^{GPe→STN} neurons dynamically represent contextual information correlating with behavioral optimality. In contrast, GPe astrocytes exhibited gradual contextual encoding independent of performance. Deleting Proto^{GPe→STN} neurons impaired adaptive responses to changing action-outcome contingencies without altering initial reward-seeking acquisition, highlighting their specific role in enabling behavioral flexibility.

Furthermore, we discovered that Proto^{GPe→STN} neurons integrate inhibitory striatal and excitatory subthalamic inputs, modulating downstream basal ganglia circuits to support flexible behavior. This research elucidates the complementary roles of Proto^{GPe→STN} neurons and astrocytes in cellular mechanisms of flexible reward-seeking behavior.

Keywords: behavioral flexibility; external globus pallidus; prototypic neuron; reward-seeking behavior.