

Towards a Computational Account of Theta Band (4-8 Hz) Power Modulation in the Subthalamic Nucleus under Response Conflict

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Presentation Abstract Summary The Subthalamic Nucleus (STN) plays a fundamental role in arresting automated responses during response conflict. It prevents premature activation of the output of the Basal-Ganglia (BG) to buy the Executive-Control (EC) system in prefrontal cortex (PFC) time to resolve the conflict and elicit more appropriate behaviors. Experiments in primates have shown that theta band (4-8 Hz) power in the Local Field Potential (LFP) and spike rates in the STN increase commensurate with the level of conflict. Moreover, recent lines of evidence suggest that the STN can act as a conflict detector by integrating competing motor signals to prevent impulsive responses. Adapting prior cellular models of STN and Globus Pallidus externus (GPe), we have built a novel large-scale biophysically constrained and reciprocally coupled subthalamopallidal (STN-GPe) network. We perturb the network with simulated cortical signals representing competing motor actions to understand the electrophysiological basis of the STN signal modulations and how cortico-STN topography impact these computations. Our results show a balance between intrinsic behaviors of the STN-GPe network and specific patterns of cortical drive is necessary for theta band expression in the network. We conjecture that theta-dependent increased spiking in the STN network is the key component for “braking” unwanted impulsive responses.

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Keywords

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