BMC Neuroscience

Poster presentation

Open Access

A conductance-based network model of the basal ganglia for probabilistic action selection

Osamu Shouno*, Johane Takeuchi and Hiroshi Tsujino

Address: Honda Research Institute Japan Co., Ltd., Wako, Saitama, 351-0188, Japan

Email: Osamu Shouno* - shouno@jp.honda-ri.com

* Corresponding author

from Sixteenth Annual Computational Neuroscience Meeting: CNS*2007
Toronto, Canada. 7–12 July 2007

Published: 6 July 2007

BMC Neuroscience 2007, **8**(Suppl 2):P172 doi:10.1186/1471-2202-8-S2-P172

The basal ganglia (BG) have been implicated in the learning of a sequence of action selections through trial-and-error. A reinforcement learning-based approach has proposed that the cortico-BG circuit is involved in three basic stages of learning: evaluation of actions, probabilistic selection of an action, and learning from experience. The striatum and mid-brain dopaminergic neurons have been suggested as neural substrates for the first and third stages. Theoretical studies have pointed out the importance of a probabilistic action selection mechanism for learning and on-line adaptation of the behavior. However, the neural substrate of the action selection is still an open question. Our hypothesis for the issue is that the indirect pathway of the BG selects an action to be executed and the direct pathway determines the timing of its execution. Using a conductance-based network model of spiking neurons, we show that the dynamics in the network of the globus pallidus external and the subthalamic nucleus in the indirect pathway provides binary modulation on the substantia nigra par reticulata, that signals a selected action. Furthermore, binary modulation occurs stochastically, and the selection probability is sensitive to inhibitory input on the globus pallidus. These results suggests that the subthalamopallidal network is capable of probabilistic action selection and the selection probability can be biased by the activities of the striatopallidal projection neurons in the indirect pathway, hence can be optimally tuned by the strength of the cortico-striatal synapses through dopamine-dependent plasticity. We conclude that the indirect pathway of the BG is a neural substrate of the probabilistic action selection.