BMC Neuroscience

Poster presentation

Realistic synaptic inputs applied to coupled oscillator model of the dopamine neuron

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

Published: 6 July 2007

BMC Neuroscience 2007, **8**(Suppl 2):P74 doi:10.1186/1471-2202-8-S2-P74

Midbrain dopamine neurons are involved in motivation and the control of movement, and have been implicated in various pathologies such as Parkinson's disease, schizophrenia and drug abuse. Dopamine neurons in the presence of their afferent inputs *in vivo* can exhibit one of several firing modes: silence, regular single-spike firing, irregular single-spike firing, and bursting. Bursts in dopamine neurons are thought to convey the reward prediction and salience signals. Dopamine neurons in a slice preparation fire spontaneously in a regular, pacemaker-like manner at a low frequency (~2–3 Hz). This regular firing appears to be driven by a subthreshold oscillation caused by interaction of a low voltage threshold, noninactivating Ca^{2+} current and a Ca^{2+}-activated small conductance K^+ current. Somatic injection of depolarizing bias current can increase the frequency of sustained firing only up to 10 Hz before the neurons go into depolarization block. Bursts observed *in vivo* have higher instantaneous frequencies. Two theories have been advanced for how higher frequencies are achieved *in vivo*. One is that during pacemaking, the natural frequencies of the soma and proximal dendrites drive the subthreshold oscillation, whereas during bursting the NMDA input to the dendrites amplifies the current associated with the distal dendritic oscillation, and drives the soma, resulting in high-frequency spiking. The other hypothesis is that the rapidly varying synaptic input (particularly the AMPA component) is not equivalent to a constant depolarizing pulse but this rapid variation can drive faster spiking that can be observed in response to a constant pulse. We have constructed a realistic multicompartmental model to test the contribution of intrinsic and synaptic currents in the dendrites to the firing pattern. The oscillatory dendrites regularize the firing pattern, decrease the frequency compared to a model in which the subthreshold oscillation is confined to the soma, and contribute to grouping of spikes into bursts.