Abstract View

INFLUENCE OF CHOLINERGIC NEUROMODULATION ON PHASE RESETING CURVES OF CORTICAL PYRAMIDAL NEURONS.

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When the membrane potential of periodically firing neurons is perturbed at various times, the next spike will be either advanced or delayed. The spike time shift as a function of the time of the perturbation is called Phase Reset Curve (PRC). PRCs can be either strictly positive (class I) or biphasic (class II). Theoretical analysis shows that spike generation dynamics determine the class of the PRC. Neurons with strong voltage-dependent spike frequency adaptation (SPA) currents should show type II PRCs, while non-adapting neurons fall under the type I spike-generating dynamics and yield class I PRCs. Blocking SPA can thus change the shape and the class of the PRC as well as spike-generating dynamics.

We test the hypothesis that the shape and/or type of the PRC can be changed by cholinergic neuromodulation through its effects on SPA currents. To this end, we recorded from layer II/III pyramidal neurons in the slices of the mouse (P28 to P35) visual cortex. Via current injection trough the patch-pipette we depolarized the neurons above threshold and injected brief current pulses at random times during the inter-spike interval to determine the phase-reset curve. This was repeated after bath application of 20¹M of the cholinergic agonist carbachol and the phase-reset curves were compared. Cholinergic neuromodulation transformed the phase-reset curve from type II to type I. Since type and shape of the PRC have important implications for neuronal synchronization behavior, such modulation can change the global behavior of cortical networks.

Citation:

B.S. Gutkin, K.M. Stiefel, S. Terry. INFLUENCE OF CHOLINERGIC NEUROMODULATION ON PHASE RESETING CURVES OF CORTICAL PYRAMIDAL NEURONS. Program No. 171.5. 2003 Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience, 2003. Online.

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