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THE CONTRIBUTION OF AFTERHYPERPOLARIZATION CURRENTS TO CHOLINERGIC ENHANCEMENT OF EXCITABILITY AND PRESERVATION OF SPIKE TIMING IN A NEOCORTICAL NEURON MODEL.

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Recent physiological studies have shown that the effects of cholinergic modulation can be different when physiologically more realistic **fluctuating** rather than **constant** depolarizing currents are injected into a neocortical neuron (see companion poster, Tang-Sejnowski, 1996). In a modified version of a 10 compartment neocortical neuron model (Bush-Sejnowski, 93), we show that the effect of cholinergic modulation is a stimulus–dependent simultaneous preservation of spike timing and enhancement of neuronal excitability. We focus on the hypothesis that although playing a dominant role in cholinergic enhancement of excitability under **constant** depolarizing input I_{AHP} is less important in the modulation of the firing rate under the physiologically more realistic **fluctuating** inputs. We first constrained the model to reproduce the phenomenon of spike frequency adaptation (SFA) and a reduction in SFA due to cholinergic modulation (modeled as a decrease in maximum conductance, g_{KCa}.) Next, by varying the fluctuation amplitude and mean intensity of the current injection, we compute a spike count–based index, D, for the contribution of I_{AHP} to enhanced excitability. We found that D can decrease as the amplitude of current fluctuation increases. This suggests that the contribution of I_{AHP} to cholinergic enhancement of neuronal excitability will be more prominent for physiologically unrealistic stimuli than that observed under *in vivo* conditions.

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