

Distance-Dependence of Nonlinear Spatial Summation in Basal Dendrites of Neocortical Pyramidal Cells

Bardia F. Behabadi and Bartlett W. Mel

The thin basal and apical oblique dendrites of pyramidal neurons receive a large fraction of the cells' excitatory inputs. Yet how these inputs are integrated remains an important open question. A recent *in vitro* study (Polsky, Mel & Schiller 2004) found that NMDA spikes contribute to a highly nonlinear (i.e. sigmoidal) summation rule when two closely spaced synaptic inputs activate the same thin branch. In contrast, as the two stimuli are increasingly spatially separated within a branch, summation grows increasingly linear, just as for inputs delivered to two different branches. We have begun to use biophysically detailed compartmental models of pyramidal neurons to study this distance dependence, and have arrived at the following tentative conclusion: the distance dependence data, which has so far been measured with one electrode held fixed at a distal site while the other is moved somatopetally, are inconsistent with the assumption of uniform excitability along the length of the branch. Rather, our findings suggest that excitability in distal thin dendrites may be several-fold greater than proximal excitability dendrites (also consistent with informal observations in the Schiller lab). Given that this type of non-uniform excitability has not previously been incorporated in pyramidal neuron models (that we know of), we are currently exploring its functional implications for synaptic integration in pyramidal neurons.