Session/Poster# Presenter
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Adaptation to Repetitive Stimuli in an Auditory Cortex Computer Model

Repetitive sensory stimuli produce reduced neuronal firing, known as adaptation. Despite reduced firing, perception is maintained. To examine possible mechanisms underlying adaptation, we used the human neocortical neurosolver (HNN), a validated computer model of primary sensory neocortical microcircuitry that replicates neocortical activity following stimuli by simulating feedforward and feedback inputs.

The HNN model consists of 200 multicompartmental pyramidal neurons (PN) and 70 inhibitory basket interneurons arranged in equal distribution in supragranular and infragranular layers (layers 2/3 and 5 respectively). We delivered four stimuli to the network with different interstimulus intervals: 50, 100, 150, 200, 300, and 400 ms. Each of the stimulus consisted of a feedforward drive arriving at the soma, followed by a feedback drive targeting the distal apical dendrites, then another drive targeting pyramidal neuronal soma, a pattern that replicates the P50, N100, and P200 event-related potentials. We also examined the role that GABA-b receptors play during adaptation.

With 50 and 100 ms interstimulus interval of repetitive stimuli, and to a lesser extent with 150 and 200 ms, we found reduced firing of layer 5 pyramidal neurons, reflecting adaptation. At an interstimulus interval of 300 ms or more, there were no changes in the firing rate of either layer 2/3 or layer 5 pyramidal neurons.

We describe a mechanism by which adaptation is associated with increased gamma oscillations arising from distinct laminar dynamics. We will next examine how interlaminar interactions and drives result in this phenomenon.