Abstract View

SYNCHRONIZATION AS A MECHANISM FOR ATTENTIONAL MODULATION

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When attention is shifted to the receptive field of a neuron, the firing of the neuron may become more synchronized with other similar units, as observed in somatosensory cortex [Steinmetz et al, Nature 404,187 (2000)], or with the local field potential at gamma frequencies, as reported for extrastriate cortex [Fries et al, Science 291, 1560 (2001)]. Using simulations, we investigated how such changes in synchrony may affect the response properties of a model downstream neuron. The synaptic drive consisted of periodic excitatory and inhibitory components, each characterized by the input rate of pulses and by a temporal jitter in their arrival times, with smaller jitter meaning higher synchrony. We found two important effects. First, when the excitatory inputs were represented by a constant depolarizing current, the output firing rate decreased sharply with increasing inhibitory jitter. In this case the synchrony of the inhibitory drive acts as a gate: for large jitter spikes are not transmitted whereas for small jitter spikes are transmitted. Second, when both excitation and inhibition fluctuated periodically but were out of phase, the gain of the curve of firing rate versus injected current changed as a function of the phase difference. These predictions were confirmed in vitro by injecting currents into rat cortical neurons using a dynamic clamp. We propose that attention may modulate the response of a circuit and change its sensitivity to stimuli by shifting the synchrony of local inhibitory neurons.
Supported by: CIRCS, Sloan-Swartz Ctr for Theoretical Neurobiology, HHMI

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