Abstract View

RAPID TEMPORAL MODULATION OF SYNCHRONY BY COMPETITION IN CORTICAL INTERNEURON NETWORKS.

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The synchrony of neurons in extrastriate visual cortex is modulated by selective attention even when there are only small changes in firing rate (Fries, P. et al., Science 291: 1560, 2001). We used Hodgkin-Huxley type models of cortical neurons to investigate the mechanism by which the degree of synchrony can be modulated independently of changes in firing rates. Because traditional methods such as cross-correlation and the spike-triggered local field potential require several hundred milliseconds of recordings and cannot measure rapid changes in the degree of synchrony, we introduced a new method to detect rapid changes in the degree of coincidence and precision of spike timing. The synchrony of local networks of model cortical interneurons interacting through GABA-A synapses was modulated on a fast time scale by selectively activating a fraction of the interneurons. The activated interneurons became rapidly synchronized and suppressed the activity of the other neurons in the network but only if the network was in a restricted range of balanced synaptic background activity: During stronger background activity the network did not synchronize, and for weaker background activity the network did not return to an asynchronous state after synchronizing. The inhibitory output of the network gated the influence of pyramidal neurons by blocking their activity during asynchronous network activity and by enhancing the impact of the stimulus-related activity of pyramidal cells during synchronous network activity that project to other cortical areas (Salinas, E. and Sejnowski, T. J., Nature Reviews Neuroscience 2: 539, 2001). Since the mean activity of the network does not change, signal transmission could be modulated without additional metabolic expense.

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