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THRESHOLD PROPERTIES OF INDIVIDUAL MODEL NEURAL OSCILLATORS CONTRIBUTE TO RAPID NETWORK SYNCHRONIZATION AND MAY POTENTIALLY PLAY A ROLE IN PERCEPTUAL FEATURE BINDING.

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The synchronization properties of locally coupled neural oscillators were investigated analytically and by computer simulation. When coupled in a manner that mimics excitatory chemical synapses, oscillators having fast–slow interactions (relaxation oscillators) were found to approach synchrony using very different mechanisms than oscillators with a more sinusoidal waveform. The relaxation oscillators make critical use of fast modulations of their thresholds, a mechanism that leads to a rate of synchronization relatively independent of coupling strength within some basin of attraction; this rate is faster for oscillators that model conductance attributes than for neural caricatures such as the FitzHugh-Nagumo equations that lack such attributes. Computer simulations of one–dimensional network arrays show that oscillators in the relaxation regime synchronize much more rapidly than oscillators with the same equations whose parameters have been modulated to yield a more sinusoidal waveform. These results suggest that the emergent synchronization behavior of oscillating neural networks can be dramatically influenced by the intrinsic properties of the network components.

In the context of the reported synchronized oscillations in visual cortex (Gray et al., Nature, 338,1989), these results show that prior conclusions (Kammen et al., 1989) drawn about the neural connectivity required for rapid synchronization do not generalize as claimed; purely local connections may yield rapid synchronization. Furthermore, under the synchronized binding hypothesis of perception, selective modulation of intrinsic oscillator properties may permit a focal subpopulation of cells to synchronize (and thus become perceptually coherent) much more rapidly than the rest of the population and thus may potentially serve as an "attentional searchlight" mechanism.

KEY WORDS: (see instructions p. 4)

1. FitzHugh-Nagumo
2. Visual Cortex
3. Attention
4. Attentional Searchlight

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