A MODEL OF LOW FREQUENCY OSCILLATORY VISUAL RESPONSES IN MACAQUE INFEROTEMPORAL CORTEX.

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Some neurons in inferotemporal cortex (IT) of the macaque monkey respond to visual stimuli by firing action potentials in a series of bursts at a frequency of around 5 Hz. We speculated that the oscillatory responses depend on competitive interactions among neurons selective for different stimuli. To test this hypothesis, we recorded neuronal responses to a preferred foveal stimulus (the 'object') presented either in isolation or against the backdrop of an already present peripheral nonpreferred stimulus (the 'flanker'). The presence of the flanker enhanced the oscillatory component of the response to the object. We have now constructed a model that can account for the experimental data. The model consists of two pools of neurons, one representing the object and the other the flanker, with reciprocal inhibition, self-excitation and adaptation. All synaptic connections exhibit synaptic depression depending on the pre-synaptic activity. We have found that depending on the strength of the inputs, synapses, adaptation, or depression, there is either oscillatory activity, both pools are active (on-on), both pools are quiescent (off-off), or one pool is active and the other is silent (on-off). Additionally, our model shows a fragile normalization phenomenon in the on-on region. In some cases, when an object and flanker are presented simultaneously, the resulting activity lies in between the activity of the object and flanker presented alone. In other cases, the activity of simultaneous presentation is additive. In the oscillatory and on-off regions, normalization was not observed. We explain mathematically why these behaviors exist in the network and make predictions for future experiments.

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