



Presentation Abstract

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Title: Reliable transmission of visual inputs into cortex depends on thalamic synchrony

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Abstract: Synchronous neuronal firing occurs in the transmission of information throughout the brain, but is difficult to quantify given experimental limitations on monitoring many synaptic inputs simultaneously. Using the reliability of firing patterns in visual cortical neurons as a measure, we estimated the number of synchronous spikes needed from thalamic relay neurons to achieve information transfer. Reliable cortical responses began to appear with as few as 20 synchronous synapses from thalamic relay neurons in a temporal integration window of less than 5 msec, which is consistent with recent estimates by others in the rat somatosensory system. We used a detailed compartmental model of a layer 4 cortical spiny stellate neuron. Data, from simultaneous *in vivo* recordings of thalamic relay neurons (in the lateral geniculate nucleus) and of simple cells in the primary visual cortex of anesthetized cats, constrained the model. We found that the firing pattern reliability of the model cell was a highly non-linear function of the number of synchronous thalamic synapses with a clearly defined region where the reliability per spike is most energetically efficient. Furthermore, this optimal range of synchronous inputs was strongly influenced by the balance of background excitation and inhibition the cell receives and by feedforward inhibition in the thalamocortical visual pathway. These results suggest that the thalamus uses synchrony to efficiently regulate inputs to the cortex through highly precise connectivity and that synchrony may be used to gate the flow of information into the cortex.

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