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ANALYSIS OF TEMPORAL DYNAMICS OF ORIENTATION SELECTIVITY IN FEEDBACK AND FEEDFORWARD MODELS OF VISUAL CORTEX.

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We previously demonstrated that inclusion of massive, local intracortical excitatory feedback into model visual cortical circuits affords a concise account of a diverse set of data on orientation selectivity (Somers et al '95, JNS, *in press*). One potential difficulty for feedback models is to account for data indicating sharp tuning within 50 msecs of response onset (Celebrini et al., '93). We have investigated the temporal dynamics of orientation selectivity in feedback, feedforward, and inhibitory model cortical circuits.

Sharp tuning (HW $< 30°$) at response onset could be achieved in all three network forms. In networks with poorly tuned thalamocortical inputs, feedforward inhibition was critical to rapid tuning. With weak feedforward inhibition, strong feedback caused damped oscillations and sharpening effects evolved over ~100 msecs. As feedforward inhibition was increased, oscillations disappeared and feedback sharpening effects occurred within a 5–50 msec transient period. This sharpening was masked by thalamocortical transients. As transient responses rise and fall, feedforward tuning broadens and sharpens (by $5-20°$). Local feedback damped these tuning changes while yielding a net sharpening. Thus both feedforward and feedback inputs can provide significant contributions to the early phase of orientation tuning.

Membrane integration properties also contributed to rapid tuning; preferred orientation responses had shorter latencies than non-preferred responses, and inhibitory neurons, because of shorter time constants, often fired before excitatory neurons. This permitted di-synaptic inhibition from preferred orientations to suppress even the first spike of non-preferred responses. Latency differences were enhanced by feedback and feedback inhibition also contributed to suppression of non-preferred spikes. Interestingly, latency differences caused non-preferred transient responses to peak after preferred responses had fallen, thus producing brief but substantial (30°) changes in the preferred orientation (Shevelev et al., '93). [Supported by MH10671 and EY07023.]

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