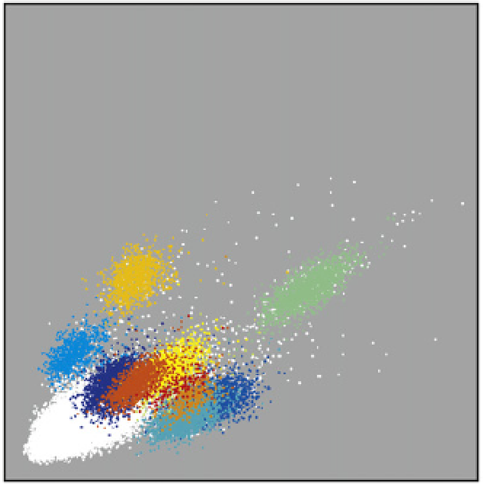
Neighbors Display Surprising Individuality



Colored clusters show peak-to-peak amplitudes of multiple neurons recorded simultaneously from primary visual cortex of an awake macaque using chronically implanted tetrodes. Image courtesy of A. Tolias.

Spike recording has frequently revealed a substantial degree of correlated firing among neighboring cortical neurons, which has been thought to result from shared inputs and to reflect the organization of the cortex into functional columns. However, recent reports by Ecker et al. (2010) and Renart et al. (2010) suggest that spiking correlations can be much weaker than previously thought, by as much as an order of magnitude. Suspecting that uncontrolled variables might account for the observations in the existing literature, Ecker et al. reassessed the question adding further experimental safeguards. These include conducting their measurements in awake macaques to avoid spontaneous oscillations that sometimes occur with anesthesia, the use of implanted tetrodes for their recording rather than electrodes whose position might become inadvertently moved, and recording from a brain area whose input could be readily regulated experimentally. For the latter they selected the primary visual cortex, the first cortical area to receive visual information from the thalamus, and measured the activities of neuronal ensembles while the macaques looked at defined visual stimuli. This analysis shows that the spiking of neighboring neurons has almost no correlated variability, suggesting that either the degree of shared input is less than previously thought or that there is some active process at work to uncouple the activity of neighboring neurons.

The findings of Renart et al. also call into question prior assumptions concerning the observed correlation in the spiking of neighboring neurons. Their analysis of rat neocortex largely resonates with the report of Ecker et al., showing almost no correlation in firing among groups of neurons in activated states of sustained firing. They further provide a theoretical underpinning for this newly discovered phenomenon, suggesting that the observed low degree of correlation could result from an active process that is inherent in the architecture of cortical networks. Their modeling indicates that the effect of shared input for a pair of neurons can be counteracted if the fluctuations in activity in their presynaptic excitatory and inhibitory inputs are themselves correlated and show that excitatory-inhibitory correlations of this kind arise naturally in recurrent circuits. Together these two papers should provide additional motivation for those mapping the fine-scale architecture of cortical microcircuits and for those seeking to determine how network architecture impacts information processing.

A.S. Ecker et al. (2010). Science ***327****, 584–587.*
A. Renart et al. (2010). Science ***327****, 587–590.*

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