RESEARCH HIGHLIGHTS

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CEREBRAL CORTEX

Reach out and touch

In the densely packed neocortex, neurons form synaptic connections with only a selected subset of their neighbours. Kalisman *et al.* investigated how neurons control this selective connectivity, and found that the axons of pyramidal neurons are not selective in terms of physical contact with neighbouring dendrites; rather, they touch the dendrites of all neighbouring neurons, but make synaptic contacts with only a few of them.

Although it is clear that pyramidal cell axons must select their targets at some level, it has been hard to discover whether they project to specific dendrites within the local microcircuit, or

instead project 'randomly' and form synapses at only a subset of contact points. To distinguish between these possibilities, Kalisman and colleagues used simultaneous multineuron recording combined with confocal microscopy to compare the functional connections between cortical neurons with their structural properties.

The key finding of the confocal microscopy was that a pyramidal neuron makes physical contact with every other neighbouring pyramidal neuron in the local microcircuit. In fact, in most cases neurons 'touch' each other several times, and the likelihood that two neurons touch is unrelated to whether they are functionally connected (as revealed by simultaneous recordings). However, neurons that were functionally connected were more likely to be connected by putative synapses, as would be expected.

The authors interpret the apparently random formation of physical contact between neurons as a kind of *tabula rasa* — a flexible pattern of potential circuitry on which can be imposed any required functional microcircuit. The large number of contacts between neighbouring pyramidal neurons could also be important for cortical plasticity, as it might allow the formation of new synapses without axons or dendrites having to change their morphology.

Rachel Jones

References and links

ORIGINAL RESEARCH PAPER Kalisman, N. *et al.* The neocortical microcircuit as a *tabula rasa*. *Proc. Natl Acad. Sci. USA* **102**, 880–885 (2005)

A confocal image of two layer 5 pyramidal cells on a background of reconstructed neurons, illustrating the fraction of choices for target cells. The upper insert shows an en passant axon 'touching' a dendrite without forming a bouton and the lower insert shows an en passant axon touching and forming a bouton at the touch site. The latter pair of neurons were synaptically connected, whereas the former were not. Image courtesy of H. Markram, Brain Mind Institute, Lausanne, Switzerland.