HIGHLIGHTS

CEREBRAL CORTEX

The more the merrier

Understanding the interplay between excitation and inhibition in the six layers of the cerebral cortex is not an easy task, particularly if we consider that most experiments become technically too demanding if they involve more than two or three recording sites at a time. Although progress has been made in obtaining simultaneous intracellular recordings from several identified cells, an alternative approach is the use of multi-electrode arrays, which allow the recording of extracellular potentials from many locations at the same time. In a recent paper in *The Journal of Neurophysiology*, Wirth and Lüscher use a 60-electrode array to investigate the flow of information along a single barrel in the somatosensory cortex of the rat.

In their initial experiments, the authors focally stimulated cortical layer (L) 4, which primarily receives the thalamic input, and analysed the spread of activity along the cortex. They found that activity did not spread to neighbouring barrels, even in the absence of inhibition, confirming the nature of the barrel as a functional cortical unit. More importantly, they found that the excitation elicited by the stimulus spread from L4 to L2/3, but only lasted a short time, as inhibition curtailed it after ~ 2 ms. By contrast, excitation in the most superficial portion of L2/3 remained active for a longer period and was sensitive to GABA antagonists, indicating that this neurotransmitter might have a direct excitatory action on the apical dendrites of L2/3 neurons.

Wirth and Lüscher also stimulated L6 directly and found a different functional interplay between excitation and inhibition in the barrel. In this case, inhibitory activity recorded in L4 preceded excitation, which developed slowly, only after inhibition had faded away. The authors explained this biphasic response by proposing the independent activation of inhibitory and excitatory pathways. So, the initial activation of inhibitory axons from L6 to L4 is followed by the response elicited by excitatory fibres, which form part of a L6–L4–L6 feedback loop.

So, inhibition shapes two spatially separate windows of excitation, which presumably modify the output of the barrel by altering the activity of L5 neurons. The way in which such a modification takes place remains to be determined, and the multi-electrode array described in this study might serve to tackle this question. Similarly, as whisker stimulation can provide input to the barrels at high frequency, it will be important to determine how plastic the interplay between excitation and inhibition is in response to repetitive stimulation.

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References and links

ORIGINAL RESEARCH PAPER Wirth, C. & Lüscher, H.-R. Spatiotemporal evolution of excitation and inhibition in the rat barrel cortex investigated with multi-electrode arrays. *J. Neurophysiol.* 19 November 2003 (doi: 10.1152/jn.00950.2003)