CEREBRAL CORTEX

Sizing up the columns

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The functional columnar organization of sensory cortices is widely thought to be underpinned by a network of structurally uniform columns of neurons. However, Oberlaender and colleagues now challenge this view by showing that the number of neurons can differ markedly between the so-called ‘barrel’ columns in the vibrissal area of the rat somatosensory cortex.

Barrel columns are the somatotopically organized cortical counterparts of facial whiskers and are used as a model system to investigate cortical organization. The authors used high-resolution, large-scale confocal microscopy in combination with automated image processing to determine the number of neurons in a defined area of the vibrissal cortex — containing 24 barrel columns — in four rats.

They found that the total number of neurons in this portion of the vibrissal cortex and its total volume were similar between the animals, indicating that neuron density in this

region is largely constant across rats. Moreover, the neuron densities in the barrel columns and the septa (the areas of cortex between the barrel columns) were similar for all of the animals.

Rats’ whiskers are arranged into multiple rows. Interestingly, the authors found that cortical thickness increased along the plane of barrel columns representing whiskers from different rows — from the barrel column representing the α whisker to that representing the E3 whisker. This reflected increases in the widths of some of the cortical layers across these barrel columns. As the neuron density in the various cortical layers was fairly constant across the vibrissal cortex, these findings indicate that the number of neurons in a barrel column depends on the whisker row that the column is associated with. By contrast, barrel column volume — and hence neuron number — varied little between barrel columns representing whiskers in the same row.

Together, these results show that barrel columns in the vibrissal cortex have a whisker-row-specific cellular organization and thereby challenge the notion of cortical column structural uniformity. Indeed, the findings may have important implications for modelling studies that are based on stereotypical cortical column units.

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