NEURONAL NETWORKS

A hub of activity

During development, coordinated activation of neuronal assemblies is essential for the establishment of proper network wiring. Theoretically, a few highly connected neurons with long-ranging connectivity, called 'hub neurons', would be the most efficient way to orchestrate network-wide synchronicity, but the existence of such cells had not been proven. Now, Cossart and colleagues have shown that subpopulations of GABA (γ-aminobutyric acid)ergic interneurons act as hub neurons in hippocampal slices.

Giant depolarizing potentials, which result from synchronization of activity across the hippocampal network, originate in CA3, making the hippocampus an ideal system for investigating the existence of hub neurons. The authors used a calcium indicator to study calcium dynamics in CA3 in hippocampal slice preparations from 5–7-day-old rats. They constructed a functional connectivity map of all recoded neurons by considering a connection between neurons A and B as functional and directional if activation of A always preceded activation of B. Only a few neurons were functionally connected to a high number of other cells, suggesting that these might be hub neurons.

To test how neurons with different degrees of connectivity contribute to the network dynamics, the authors stimulated neurons and simultaneously imaged population activity in real time. Some of the cells with a high degree of connectivity (8 out of 20 cells) stimulated network interactions, suggesting that they function as hub neurons.

The hippocampus comprises mainly two cell types, namely glutamatergic pyramidal cells and GABAergic interneurons. Investigation of hippocampal slices from transgenic mice in which hippocampal interneurons were fluorescently labelled revealed that all neurons fulfilling the criteria of hub neurons belonged to this neuronal population. Further analysis found that these hub neurons had one of two specific axonal morphologies: long-reaching connections and sparse collaterals, or a dense and local arborization. Only cells with the dense and local arborization could trigger network synchronization; however, it is possible that long-reaching connections had been cut off during slice preparation.

This paper reveals evidence that GABAergic interneurons function as hub neurons and narrows the gap in our understanding of communication between single cells and synchronization of network activity.

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ORIGINAL RESEARCH PAPER Bonifazi, P. *et al.* GABAergic hub neurons orchestrate synchrony in developing hippocampal networks. *Science* **326**, 1419–1424 (2009)
FURTHER READING Blankenship, A. G. & Feller, M. B. Mechanisms underlying spontaneous patterned activity in developing neural circuits. *Nature Rev. Neurosci.* **11**, 18–29 (2010)