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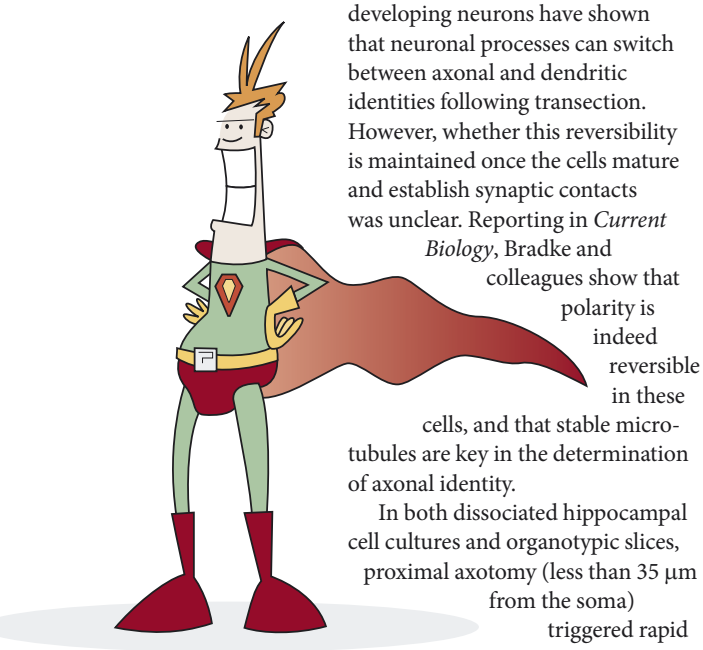
NEURONAL POLARITY

Changing identity



Neurons develop specialized compartments for receiving (dendrites) and transmitting (axons) cellular signals; these compartments enable effective transmission in neuronal circuits. *In vitro* studies on the initial establishment of polarity in developing neurons have shown that neuronal processes can switch between axonal and dendritic identities following transection. However, whether this reversibility is maintained once the cells mature and establish synaptic contacts was unclear. Reporting in *Current Biology*, Bradke and colleagues show that polarity is indeed reversible in these cells, and that stable microtubules are key in the determination of axonal identity.

In both dissociated hippocampal cell cultures and organotypic slices, proximal axotomy (less than 35 μm from the soma) triggered rapid growth of one or more of the existing dendrites. Moreover, after 24 hours the identity of these processes had changed: expression of the dendritic marker MAP2 had decreased whereas that of the axonal marker TAU1 had increased. Importantly, after 5 days these transformed processes were able to form functional synapses and restore connectivity, as assessed by immunocytochemistry and FM4-64 labelling. Synapsin-1-positive vesicles were found apposed to PSD95-labelled postsynaptic densities in neighbouring dendrites, and synaptic vesicle cycling was observed. The proximally lesioned axon did not elongate and lost its axonal identity.

By contrast, when axons were cut more than 35 μm away from the cell body they were able to regrow, suggesting that the cell was still able to recognize the axonal identity of this process and trigger regeneration. This finding led the authors to search for a distal axonal marker.

Previous studies have identified microtubule stabilization as a key step in the initial specification of axons. Here the authors showed that in mature neurons the stability of microtubules in the distal part of axons is higher than in dendrites, and that pharmacological stabilization of microtubules is sufficient to induce the transformation of differentiated dendrites into axons.

Together these results show that mature neurons remain plastic with respect to their polarity. They also highlight the importance of microtubule dynamics in the specification and maintenance of axons. It remains to be determined whether the mechanisms that increase microtubule stability in axons can be harnessed to promote neuronal regeneration after injury.

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ORIGINAL RESEARCH PAPER Gomis- Rüth, S., Wierenga, C. -J. & Bradke, F. Plasticity of polarization: changing dendrites into axons in neurons integrated in neuronal circuits. *Curr. Biol.* **18**, 992–1000 (2008)

FURTHER READING Arimura, N. & Kaibuchi, K. Neuronal polarity: from extracellular signals to intracellular mechanisms. *Nature Rev. Neurosci.* **8**, 194–205 (2007)