Astrocytes and synaptic plasticity

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By mopping up excess neurotrophic factor from neuronal synapses, astrocytes may finely tune synaptic transmission to affect processes such as learning and memory, say Bergami et al.

The major cellular events of learning and memory are long-term potentiation (LTP) and long-term depression (LTD), both of which affect neurons' ability to communicate with one another. Neurons that have undergone LTP display a stronger electrical response to the same level of a stimulus, whereas neurons that have gone through LTD display a weaker response. These changes are thought to result from modifications of the neuronal synapses, such as alterations in the density of postsynaptic receptors, or downstream signaling events.

Secretion of the neurotrophic factor BDNF (brain-derived neurotrophic factor) has been implicated in long-term synaptic modification, and the function of BDNF on synaptic strength depends on its particular form: in its pro-BDNF form it is believed to promote LTD, and in its mature form it prompts LTP. Neurons were thought to secrete pro-BDNF, which then matured into BDNF in the synaptic space. However, a recent study suggests that only mature BDNF is secreted, pro-BDNF being processed intracellularly.

To get to the bottom of things, Bergami et al. investigated the fate of both forms after LTP induction in brain slices from the rat cortex. By fluorescent immunohistochemistry they showed that that neurons indeed secrete both mature and pro-BDNF, but that a large amount of the pro-BDNF is immediately taken up by astrocytes.

Astrocytes, previously thought to be unimportant in neuronal transmission, have recently been implicated in long-term modulation of neuronal synapses. For example, they release the neurotransmitter glutamate into the synapse prompting LTP. By specifically mopping up pro-BDNF, astrocytes seem to have another means to assist in LTP. However, while it's likely that most pro-BDNF gets degraded inside astrocytes, say the authors, some gets recycled and re-released, suggesting that astrocytes in fact fine-tune synaptic plasticity.

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