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How the brain stabilizes connections in order to learn better

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Summary: Throughout our lives, our brains adapt to what we learn and memorize. The brain is indeed made up of complex networks of neurons and synapses that are constantly re-configured. However, in order for learning to leave a trace, connections must be stabilized. A team researchers has now discovered a new cellular mechanism to help understand this.

FULL STORY

Throughout our lives, our brains adapt to what we learn and memorize. The brain is indeed made up of complex networks of neurons and synapses that are constantly re-configured. However, in order for learning to leave a trace, connections must be stabilized. A team at the University of Geneva (UNIGE) discovered a new cellular mechanism involved in the long-term stabilization of neuron connections, in which non-neuronal cells, called astrocytes, play a role unidentified until now. These results, published in *Current Biology*, will lead to a better understanding of neurodegenerative and neurodevelopmental diseases.

The central nervous system excitatory synapses -- points of contact between neurons that allow them to transmit signals -- are highly dynamic structures, which are continuously forming and dissolving. They are surrounded by non-neuronal cells, or glial cells, which include the distinctively star-shaped astrocytes. These cells form complex structures around synapses, and play a role in the transmission of cerebral information which was widely unknown before.

Plasticity and Stability

By increasing neuronal activity through whiskers stimulation of adult mice, the scientists were able to observe, in both the somatosensory cortex and the hippocampus, that this increased neuronal activity provokes an increase in astrocytes movements around synapses. The synapses, surrounded by astrocytes, re-organise their architecture, which protects them and increases their longevity. The team of researchers led by Dominique Muller, Professor in the Department of Fundamental Neuroscience of the Faculty of Medicine at UNIGE, developed new techniques that allowed them to specifically "control" the different synaptic structures, and to show that the phenomenon took place exclusively in the connections between neurons involved in learning. "In summary, the more the astrocytes surround the synapses, the longer the synapses last, thus allowing learning to leave a mark on memory," explained Yann Bernardinelli, the lead author on this study.

This study identifies a new, two-way interaction between neurons and astrocytes, in which the learning process regulates the structural plasticity of astrocytes, who in turn determine the fate of the synapses. This mechanism indicates that astrocytes apparently play an important role in the processes of learning and memory, which present abnormally in various neurodegenerative and neurodevelopmental diseases, among which Alzheimer's, autism, or Fragile X syndrome.

This discovery highlights the until now underestimated importance of cells which, despite being non-neuronal, participate in a crucial way in the cerebral mechanisms that allow us to learn and retain memories of what we have learned.

Story Source:

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Journal Reference:

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