Scientists report capturing first image of memories being made

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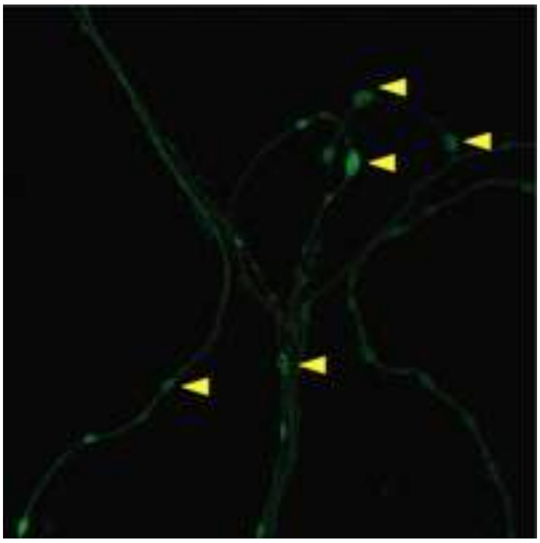
Courtesy McGill University and World Science staff



Researchers say they have captured the first image of a mechanism underlying long-term memory formation, called protein translation.

The finding provides the first visual evidence that when a new memory is formed new proteins, types of large molecules, are produced at synapses, or connections between nerve cells, according to the scientists.

The process, they explained, boosts the strength of the connection and reinforces the memory.

The study by researchers at the Montreal Neurological Institute and Hospital, McGill University in Montreal, and and University of California, Los Angeles was published in the June 19 issue of the research journal Science.

When considering what might be going on in the brain at a molecular level two properties of memory must be taken into account, said Wayne Sossin, a neuroscientist at the institute and and co-investigator in the study. First, because a lot of information needs to be maintained over a long time there must be some stability. Second, to allow for learning and adaptation the system also needs to be highly flexible.

For this reason, research has focused on synapses which are the main site of exchange and storage in the brain. They form a vast but also constantly fluctuating network of connections whose ability to change and adapt, called synaptic plasticity, may be the fundamental basis of learning and memory, according to Sossin.

“But, if this network is constantly changing, the question is how do memories stay put, how are they formed? It has been known for some time that an important step in long-term memory formation is ‘translation,’ or the production, of new proteins locally at the synapse, strengthening the synaptic connection in the reinforcement of a memory, which until now has never been imaged,” said Sossin.

“Using a translational reporter, a fluorescent protein that can be easily detected and tracked, we directly visualized the increased local translation, or protein synthesis, during memory formation. Importantly, this translation was synapse-specific and it required activation of the post-synaptic cell,” that is, the cell receiving a signal across the synapse, he added.

Thus “this step required cooperation between the pre and post-synaptic compartments, the parts of the two neurons [nerve cells] that meet at the synapse. Thus highly regulated local translation occurs at synapses during long-term plasticity.”

Long-term memory and synaptic plasticity require changes in gene activity and yet can occur in a synapse-specific manner, the researchers said. This study provides evidence, they added, that a mechanism behind this gene activation during neuronal plasticity involves controlled protein translation at synapses. These findings will help establish the molecular processes involved in long-term memory formation and offer insight into diseases involving memory impairment, Sossin and colleagues predicted.

Image: The increase in green fluorescence, in dicated by the arrow heads, represents the imaging of local translation at synapses during long-term plasticity, researchers say. (Courtesy Science)