MedicalXpress

How neurons remember: A Calcium-dependent mechanism of neuronal information storage

July 20 2015

Research findings obtained over the past decades increasingly indicate that stored memories are coded as permanent changes of neuronal communciation and the strength of neuronalinterconnections. The learning process evokes a specific pattern of electrical activity in these cells, which influences the response behavior to incoming signals, the expression of genes and the cellular morphology beyond the learning process itself.

"You might say that these changes define the cellular correlate of the memory engram" says Friedrich Johenning, researcher at the Neuroscience Research Center and one of the study's two co-lead authors. "Our work focuses on identifying physiological mechanisms through which a neuron can implement long-term changes of its response", adds the other co-lead author Anne-Kathrin Theis.

In their study the scientists succeeded in demonstrating that the spine calcium response to action potentials back-propagating into the dendritic tree can undergo long-term enhancement. Spines are small but important dendritic processes that facilitate communication between neurons. Whenever a back-propagating action potential encounters such a spine, the calcium concentration within the spines changes due to the rapid influx of calcium ions from the outside via ion channelson the plasmamembrane. In addition, the intracellular ryanodine receptor gets activated, which triggers the release of calcium stored in the cell. This

store release results in a long-term modification of the calcium response elicited by electrical impulses inside the spine. It should be noted that these changes are local in nature and limited to individual spines—the neighboring processes remain unaffected.

"The challenge is to now ascertain exactly what influence these spine-specific, long-term, altered calcium responses exert on the synaptic communication between the neurons. It is also important for us to establish a relationship to pathological calcium response changes occurring in the context of neuropsychiatric diseases", according to Dietmar Schmitz, senior author and head of the study.

More information: *PLoS Biol.* 2015 Jun 22;13(6):e1002181. DOI: 10.1371/journal.pbio.1002181.

Provided by Charité - Universitätsmedizin Berlin