Researchers identify 'switch' for long-term memory

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Neurobiologists at Heidelberg University have identified calcium in the cell nucleus to be a cellular "switch" responsible for the formation of long-term memory. Using the fruit fly Drosophila melanogaster as a model, the team led by Prof. Dr. Christoph Schuster and Prof. Dr. Hilmar Bading investigates how the brain learns. The researchers wanted to know which signals in the brain were responsible for building long-term memory and for forming the special proteins involved. The results of the research were published in the journal *Science Signaling*.

The team from the Interdisciplinary Center for Neurosciences (IZN) measured nuclear calcium levels with a fluorescent protein in the association and learning centres of the insect's brain to investigate any changes that might occur during the learning process. Their work on the fruit fly revealed brief surges in calcium levels in the cell nuclei of certain neurons during learning. It was this calcium signal that researchers identified as the trigger of a genetic programme that controls the production of "memory proteins". If this nuclear calcium switch is blocked, the flies are unable to form long-term memory.

Prof. Schuster explains that insects and mammals separated evolutionary paths approximately 600 million years ago. In spite of this sizable gap, certain vitally important processes such as memory formation use similar cellular mechanisms in humans, mice and flies, as the researchers' experiments were able to prove. "These commonalities indicate that the formation of long-term memory is an ancient phenomenon already present in the shared ancestors of insects and vertebrates. Both species probably use similar cellular mechanisms for forming long-term memory, including the nuclear calcium switch", Schuster continues.

The IZN researchers assume that similar switches based on nuclear calcium signals may have applications in other areas – presumably whenever organisms need to adapt to new conditions over the long term. "Pain memory, for example, or certain protective and survival functions of neurons use this nuclear calcium switch, too", says Prof. Bading. This cellular switch may no longer work as well in the elderly, which Bading believes may explain the decline in memory typically observed in old age. Thus, the discoveries by the Heidelberg neurobiologists open up new perspectives for the treatment of age- and illness-related changes in brain functions.

More information: Weislogel, J. et al. Requirement for Nuclear Calcium Signaling in Drosophila Long-Term Memory, *Science Signaling* 6 (274), ra33, 07 May 2013. doi: 10.1126/scisignal.2003598

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