New research increases understanding of learning, memory

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(Medical Xpress) -- New international research on how fruit flies learn to ignore a constant smell, which increases understanding of behavioural habituation, has been recently published in the leading international journal *PNAS*.

'Habituation' is a ubiquitous psychological phenomenon in which constant exposure to a stimulus results in a weakened response. Despite the ubiquity of habituation, and its importance for cognitive filtering required to efficiently identify new and important events, to date the neural mechanism of habituation has remained largely unexplained.

Professor of Neurogenetics, Mani Ramaswami's research group at the Trinity College Institute of Neuroscience, the School of Genetics and Microbiology, and School of Natural Sciences at Trinity College Dublin, collaborated with Prof Veronica Rodrigues' group in the National Center for Biological Sciences, Bangalore to understand how fruit flies (Drosophila melanogaster) habituate to a constant smell. The TCD research was funded by the Science Foundation Ireland.

Fruit flies show easily measured forms of olfactory habituation. Using fruit flies for their experiments, allowed these scientists to combine genetic and anatomical techniques with high-speed brain imaging to study how olfactory responses in the living brain change during olfactory habituation.

The research shows that continuous exposure to a smell causes the brain

cells that receive signals from the antenna (the fly's nose) to show a reduced response to odour. This reduction is not because sensory cells in antenna do not respond to the smell. Rather, it is because after habituation, brain cells that respond to this specific smell now begin to receive a strong inhibitory signal from another group of cells. These inhibitory cells release a negative neurotransmitter called GABA in response to smell. Several experiments reveal unexpected and interesting ways by which this inhibitory signal becomes stronger.

In a commentary in the same issue of PNAS, UCLA Neuroscientist, Professor David Glanzman observes that: "Ramaswami and colleagues' important insights into the cellular and molecular mechanisms of olfactory habituation in Drosophila are likely to generalise to other forms of habituation in other species, including mammalian species."

Professor Ramaswami explained: "In all brain regions, positive (excitatory) cells stimulate not only other excitatory cells but also turn on 'negative' (inhibitory) cells that dampen this excitation. If prolonged stimulation of any group of excitatory cells selectively strengthens its specific negative connections, then more complex and non-olfactory forms of habituation could also be explained."

"It is also pleasing that this mechanism for habituation can theoretically explain the phenomenon of dishabituation, which psychologists have always felt is a defining property of habituation. There are times when it is important to 'dishabituate' or suddenly pay keen attention to what was previously a boring background. When you hear a tiger snarl in the forest for example, every blade of grass draws your attention."

In this *PNAS* paper, the authors suggest that stimuli such as a tiger's snarl, may work in part by causing inhibition of inhibitory neurons and thus restore the brain to its original (or even enhanced) behavioral state.

“Furthermore because defects in habituation are associated with human neuropsychiatric disorders, this work may also define an accessible neural circuit in which to identify neuronal functions of genes associated with human susceptibility to autism and psychosis,” concluded Professor Ramaswami.

More information: The full article, entitled ‘Plasticity of local GABAergic interneurons drives olfactory habituation’, is available online .

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