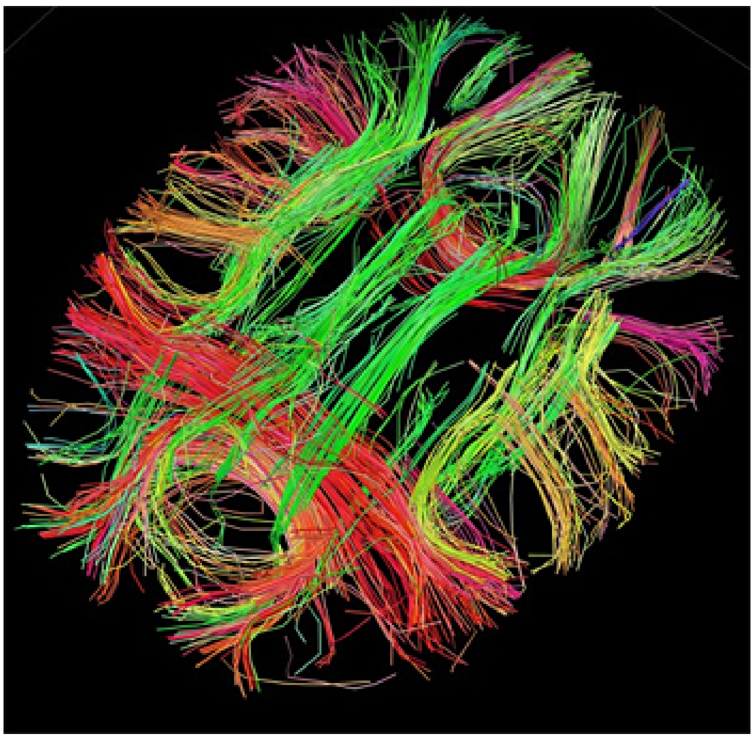
Medical Xpress

Groundbreaking model explains how the brain learns to ignore familiar stimuli

June 18 2014



White matter fiber architecture of the brain. Credit: Human Connectome Project.

A neuroscientist from Trinity College Dublin has proposed a new, ground-breaking explanation for the fundamental process of 'habituation', which has never been completely understood by neuroscientists.

Typically, our response to a stimulus is reduced over time if we are repeatedly exposed to it. This process of habituation enables organisms to identify and selectively ignore irrelevant, familiar objects and events that they encounter again and again. Habituation therefore allows the brain to selectively engage with new stimuli, or those that it 'knows' to be relevant. For example, the unusual sensation created by a spider walking over our skin should elicit an appropriate evasive response, but the touch of a shirt or blouse on the same skin should be functionally ignored by the nervous system. If habituation does not occur, then such unimportant stimuli become distracting, which means that complex environments can become overwhelming.

The new perspective on the way habituation occurs has implications for our understanding of neuropsychiatric conditions, because normal habituation, emotional responses and attentional abilities are altered in several of these conditions. In particular, hypersensitivity to complex environments is common in individuals on the autism spectrum.

Habituation has long been recognised as the most fundamental form of learning, but it has never been satisfactorily explained. In a Perspective article just published in the leading international journal *Neuron*, Professor of Neurogenetics in the School of Genetics & Microbiology at Trinity, Mani Ramaswami, explains habituation through what he terms the 'negative-image model.' The model proposes and explains how a repeated activation of any group of neurons that respond to a given stimulus results in the build-up of 'negative activation', which inhibits responses from this same group of cells.

For example, the first view of an unfamiliar and scary face can trigger a fearful response. However after multiple exposures, the group of neurons activated by the face is less effective at activating fear centres because of increased inhibition on this same group of neurons. Significantly, a strong response to new faces persists for much longer in people on the autism spectrum. This matched increase in inhibition (the 'negative image'), proposed to underlie habituation, is not normally consciously perceived but it can be revealed under particular conditions.

Professor Ramaswami said: "This Perspective outlines scalable circuit mechanisms that can account for habituation to stimuli encoded by very small or very large assemblies of neurons. Its strength is its simplicity, its basis in experimental data, and its ability to explain many features of habituation. However, more high-quality studies of habituation mechanisms will be required to establish its generality."

Professor of Experimental Brain Research at Trinity, and Director of the Trinity College Institute for Neuroscience, Shane O'Mara, said: "The arguments and ideas expressed by Professor Ramaswami should lead to additions and changes to our current text-book sections on habituation, which is a process of great relevance to cognition, attention and psychiatric disease. It is possible that highlighting the process of negative image formation as crucial for habituation will prove useful to clinical genetic studies of autism, by helping to place diverse autism susceptibility genes in a common biological pathway."

Provided by Trinity College Dublin

Citation: Groundbreaking model explains how the brain learns to ignore familiar stimuli (2014, June 18) retrieved 27 April 2024 from https://medicalxpress.com/news/2014-06-groundbreaking-brain-familiar-stimuli.html