

Making or breaking habits: The endocannabinoids can do it

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In our daily lives we constantly have to shift between habitual and goaldirected actions. For example, having to drive to a new place instead of driving home. Difficulties with stopping habits and shifting to goaldirected control underlie a number of neuropsychiatric disorders, including obsessive-compulsive disorder and addiction. How does the brain control this fundamental process?

In an article published today (May 26, 2016), in the scientific journal *Neuron*, a collaborative study between scientists at the National Institute on Alcohol Abuse and Alcoholism (NIAAA/NIH, MD, USA), MIT (MA, USA), Stanford University (CA, USA), University of California San Diego (CA, USA) and the Champalimaud Centre for the Unknown (Lisbon, Portugal) shows that it's all a matter of controlling the level of activity in a specific brain region called the orbitofrontal cortex (OFC). This brain area is known to participate in goal-directed actions by supplying information about outcome values, perhaps via projections to dorsomedial striatum.

This new study identified an endogenous molecular mechanism through which the brain reduces the flow of information in the OFC, a process that, according to the results of the study, promotes the formation of habits. "Our results suggest that alterations in the brain's endogenous endocannabinoid neuromodulatory system could be blocking the brain's capacity to "break habits" as observed in disorders that affect switching between goal-directed and habitual behaviours. In other words, endocannabinoids act as a brake in the OFC, allowing for habit



formation.", says Christina Gremel, the lead author of this study, currently an assistant professor of Psychology at University of California San Diego and affiliated with the Neuroscience Graduate program.

In this study, scientists trained the same mouse to make the same action in either a goal-directed, or habitual manner. David Lovinger, a senior investigator at NIAAA/NIH, explains "Mice were trained to perform the same action in 2 different environments for the same food reward, but under different action requirements that differentially biased the animal toward the development of goal-directed versus habitual actions. This newly developed procedure allowed us to probe the brain mechanisms involved in shifting action strategies."

Since reduced activity in the neurons of the OFC is thought to underlie habit formation, and endocannabinoids are known to reduce the activity of neurons in general, the authors hypothesised that endocannabinoids could be playing a key role in <u>habit formation</u>. When the authors selectively deleted a particular endocannabinoid receptor, called cannabinoid type 1, from the OFC projection neurons, they observed that mice who were lacking these receptors did not form habits.

For Rui Costa, principal investigator at the Champalimaud Centre for the Unknown, "Our work directly demonstrates that parallel brain circuits mediating goal-directed versus habitual actions compete for control over behaviour. Drugs of abuse and <u>neuropsychiatric disorders</u> affecting decision-making change the balance between habitual and goaldirected actions. Based on our findings, we could possibly restore this balance between action strategies by targeting the brain's endocannabinoid system; thereby breaking <u>habitual control</u> over behaviour and alleviating suffering in disorders involving these processes."

More information: Christina M. Greme et al., Endocannabinoid



Modulation of Orbitostriatal Circuits Gates Habit Formation, *Neuron* (2016). DOI: 10.1016/j.neuron.2016.04.043

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