

Researchers find similarities in brain activity for both habits and goals

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A team of researchers has found that pursuing carefully planned goals and engaging in more automatic habits shows overlapping neurological mechanisms. Because the findings, which appear in the latest issue of the journal *Neuron*, show a neurological linkage between goal-directed and habitual, and perhaps damaging, behaviors, they may offer a pathway for beginning to address addiction and similar maladies.

The study was conducted by researchers at New York University's Center for Neural Science and Department of Psychology, Princeton University's Department of Psychology and Neuroscience Institute, and University College London's Wellcome Trust Centre for [Neuroimaging](#) and Gatsby Computational Neuroscience Unit, University College London.

The [brain](#) is believed to engage in two types of decision-making processes—deliberative, in which the future consequences of potential actions are weighed in order to achieve a particular goal, and automatic or habitual, in which previously successful actions are repeated without further contemplation. While the mechanisms behind these behaviors are distinct—with goal-directed actions the result of planning and habitual ones, associated with addiction, produced more thoughtlessly—researchers have had difficulty separating them behaviorally as they both typically pursue common ends.

The researchers on the *Neuron* study sought to differentiate both types of decision making by studying how humans' decisions and [brain activity](#), measured using functional magnetic resonance imaging (fMRI), were influenced by previously received vs. potential future rewards in a gambling game.

In the experiments, subjects were asked to make two sets of choices, with a monetary reward given if they made certain selections. In the first set of

choices, subjects were asked to make selections between different slot machines, represented by colored boxes. These choices led to the opportunity to choose between additional slot machines. If the subjects made certain choices in this second stage, they received a monetary reward. Each subject repeated this process 200 times, with the chance of winning a monetary reward varying in each round—in some rounds, certain selections were associated with a high chance of winning money; in other rounds, these same choices were much less likely to yield a monetary benefit.

By analyzing how subjects adjusted their choices based on winning, or failing to win, money, the researchers were able to distinguish goal-directed from habitual decisions. Since the chances of winning money for different choices were constantly changing, a habitual decision, which is based on repeating a previously rewarded choice, was distinct from a goal-directed one, which is based on contemplating the future outcome expected for the action.

Having dissociated the two types of decisions, the researchers examined brain activity related to decision processes. Despite the distinctions between goal-directed and habitual behaviors, the subjects' brain activity was similar for both types of action. Indeed, signals related to goal-directed plans were observed in an area of the brain known as the ventral striatum, which is normally associated with habits and drug abuse.

"This surprising result shows that the brain's systems for different behaviors are more intertwined than previously thought," explained Nathaniel Daw, an assistant professor in NYU's Center for Neural Science and Department of Psychology, one of the study's co-authors.

The authors added that the finding paves the way for seeking to understand how the brain regulates between goal-directed and habitual behaviors. By

comprehending the mechanisms by which the brain controls these behaviors, subsequent research can begin to address how to curb habitual behaviors such as drug addiction or alcoholism. More specifically, because these decisions have a common neural target, there is a possibility that therapeutic methods could be designed and tested, targeting this locus, to enhance goal-directed behaviors while diminishing habitual ones.

Provided by New York University

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