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Forgetting helps you remember the important stuff, psychologists say

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For the first time, Stanford researchers using functional magnetic resonance imaging (fMRI) have discovered that the brain's ability to suppress irrelevant memories makes it easier for humans to remember what's really important.

"It's somewhat of a counter-intuitive idea," said Brice Kuhl, a doctoral student working in the lab of Associate Professor Anthony Wagner of the Psychology Department. "Remembering something actually has a cost for memories that are related but irrelevant." But this cost is beneficial: The brain's ability to weaken unimportant memories and experiences enables it to function more efficiently in the future, Kuhl said.

Kuhl and Wagner's findings were published online June 3 in *Nature Neuroscience* in an article titled "Decreased Demands on Cognitive Control Reveal the Neural Processing Benefits of Forgetting."

According to Wagner, the findings demonstrate the brain's ability to discard irrelevant memories. "Any act of remembering re-weights memories, tweaking them to try to be more adaptive for the next time you try to remember something," he said. "The brain is plastic—adaptive—and one feature of that is not just strengthening some memories but also suppressing or weakening others."

This function, which is carried out in the prefrontal cortex region behind the forehead, helps the brain; it doesn't have to work as hard in the

future when it tries to remember an important memory because the competing but irrelevant memories have been weakened. "The prefrontal cortex is the CEO of the brain; it governs cognition, bringing [memories] into line with your goals," Wagner said. "It's an important property of our memory system that the memories change in both directions—they get both stronger and weaker—and that this confers benefits," by allowing the brain to use less of its computational resources to recall what's important, thereby making them available for other processes.

Memory allows humans to be predictive about what's likely to be relevant to them as they go through life, Wagner explained. "What forgetting does is allow the act of prediction to occur much more automatically, because you've gotten rid of competing but irrelevant predictions," he said. "That's very beneficial for a neural information processing system."

The act of remembering is a complex cognitive activity because memory is associative, Wagner said, meaning that when someone, for example, thinks about what they ate for lunch the day before, it's likely to tap into memories of other lunches. "In order to remember, we need a set of mechanisms that allows us to select and target the memories we want, and allow them to win out over competing but irrelevant memories," he said. "So, initially, any act of retrieval is very resource intensive and places heavy demands on attention mechanisms in the prefrontal cortex." But when the competing but unimportant memories are successfully suppressed, fewer demands are placed on the frontal lobes to remember the relevant memories.

Dueling passwords and the experiment

In everyday life, memories compete with one another. For example, a bank may require clients to change their passwords every six months for security reasons. Initially, a client has only one password to remember.

But when a new password is introduced, that person's efforts to remember it compete with his or her memory of the old one, and the mechanisms in the prefrontal cortex have to work hard to resolve which one to remember. "The extent to which these brain mechanisms weaken the old password, then they don't have to be used as much in future attempts to remember the new one," Wagner said. "From a neural standpoint, forgetting the old password makes the brain more efficient." With the help of fMRI, the psychologists demonstrated this benefit in their experiment.

Twenty Stanford students, 18 to 32 years old, took part in a three-hour study held in the Richard M. Lucas Center for Magnetic Resonance Spectroscopy and Imaging at Stanford. Each participant was given 40 cue words and six attached associate words, such as ATTIC-junk and ATTIC-dust. Each word pair flashed for four seconds on a screen inside the scanner.

"The key is that there were six memories being built for each cue word—six memories that might fight it out during attempts to remember," Wagner said. The participants had to practice remembering the pairs and were given cues, such as ATTIC-j, to enhance their ability to remember ATTIC-junk over other competing word pairs. The students practiced the prompted word pair ATTIC-junk three times as the scanner recorded their brain activity. The first time they practiced a pair, the prefrontal cortex actively "lit up" as it worked hard to form the new memory while competing with the other word pairs. However, when the students practiced remembering the prompted word pair for a second and third time, their frontal lobes became less active. "Critically, we observed a relationship between the level of this decrease in prefrontal activity and how likely it was that the participant would later forget the competing irrelevant pairs," Kuhl said. After about 20 minutes, the volunteers were tested on all the word pairs and, as expected, they best remembered the pairs they had practiced and forgot the competing

words. Moreover, the participants who forgot the most were the ones who showed the greatest decrease in prefrontal activity.

Although such behavior concerning memory and forgetting has been previously demonstrated, Kuhl said, the new study for the first time reveals the neural benefits of such forgetting. "The motivation for doing the study was to link the changes in brain activity during selective remembering with later forgetting," he said. "This relationship powerfully illustrates a primary benefit of forgetting: As irrelevant memories are forgotten, the neural systems that help us remember do not need to work as hard," Wagner said. "While forgetting can be frustrating, it may represent a fundamental benefit for our ability to remember."

In addition to Kuhl and Wagner, co-authors are Nicole Dudukovic, a Stanford doctoral student in psychology, and Itamar Kahn, a former student in Wagner's lab who is now a postdoctoral fellow at Harvard University.

Source: Stanford University