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Brain Has Biological Mechanism To Block Unwanted Memories

01/08/04 -- For the first time, researchers at Stanford University and the University of Oregon have shown that a biological mechanism exists in the human brain to block unwanted memories.

The findings, to be published Jan. 9 in the journal Science, reinforce Sigmund Freud's controversial century-old thesis about the existence of voluntary memory suppression.

"The big news is that we've shown how the human brain blocks an unwanted memory, that there is such a mechanism and it has a biological basis," said Stanford psychology Professor John Gabrieli, a co-author of the paper titled "Neural Systems Underlying the Suppression of Unwanted Memories." "It gets you past the possibility that there's nothing in the brain that would suppress a memory - that it was all a misunderstood fiction."



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The experiment showed that people are capable of repeatedly blocking thoughts of experiences they don't want to remember until they can no longer retrieve the memory, even if they want to, Gabrieli explained.

Michael Anderson, a psychology professor at the University of Oregon and the paper's lead author, conducted the experiment with Gabrieli and other researchers during a sabbatical at Stanford last year.

"It's amazing to think that we've broken new ground on this - that there is a clear neurobiological basis for motivated forgetting," Anderson said. "Repression has been a vague and controversial construct for over a century, in part because it has been unclear how such a mechanism could be implemented in the brain. The study provides a clear model for how this occurs by grounding it firmly in an essential human ability - the ability to control behavior."

In recent years, the question of repressed memory has attracted considerable public attention concerning cases involving childhood sexual abuse. "That was very controversial because it went through two pendulum swings," Gabrieli said. "The first swing was that people thought, 'What a horrible thing.' The second was that people said, 'How many of these might be false memories?' Then people started asking does repressed memory even exist, and can you show that experimentally or scientifically?"

Anderson first revealed the existence of such a suppression mechanism in the brain in a 2001 paper published in Nature titled "Suppressing Unwanted Memories by Executive Control." He took the research a step further at Stanford by using brain imaging scans to identify the neural systems involved in actively suppressing memory. The core findings showed that controlling unwanted memories was associated with increased activation of the left and right frontal cortex (the part of the brain used to repress memory), which in turn led to reduced activation of the hippocampus (the part of the brain used to remember experiences). In addition, the researchers found that the more subjects activated their frontal cortex during the experiment, the better they were at suppressing unwanted memories.

"For the first time we see some mechanism that could play a role in active forgetting," Gabrieli said. "That's where the greatest interest is in terms of practical applications regarding emotionally disturbing and traumatic experiences, and the toxic effect of repressing memory." The Freudian idea is that even though someone is able to block an

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unpleasant memory, Gabrieli said, "it's lurking in them somewhere, and it has consequences even though they don't know why in terms of their attitudes and relationships."

The experiment

Twenty-four people, aged 19 to 31, volunteered for the experiment. Participants were given 36 pairs of unrelated nouns, such as "ordeal-roach," "steam-train" and "jaw-gum," and asked to remember them at 5-second intervals. The subjects were tested on memorizing the word pairs until they got about three-quarters of them right - a process that took one or two tries, Anderson said.

The participants then were tested while having their brains scanned using functional magnetic resonance imaging (fMRI) at Stanford's Lucas Center for Magnetic Resonance Spectroscopy. The researchers randomly divided the 36 word pairs into three sets of 12. In the first set, volunteers were asked to look at the first word in the pair (presented by itself) and recall and think about the second word. In the second set, volunteers were asked to look at the first word of the pair and not recall or think of the second word. The third set of 12 word pairs served as a baseline and was not used during the brain scanning part of the experiment. The subjects were given four seconds to look at the first word of each pair 16 times during a 30-minute period.

After the scanning finished, the subjects were retested on all 36 word pairs. The researchers found that the participants remembered fewer of the word pairs they had actively tried to not think of than the baseline pairs, even though they had not been exposed to the baseline group for a half-hour.

"People's memory gets worse the more they try to avoid thinking about it," Anderson said. "If you consistently expose people to a reminder of a memory that they don't want to think about, and they try not to think about it, they actually don't remember it as well as memories where they were not presented with any reminders at all."

Implications of the study

Gabrieli said the findings contradict human intuition. "What's funny about that, from a psychological viewpoint, is that mostly people are quite the opposite in life - a very unpleasant thing intrudes into their thinking," he said. "They ruminate, it bothers them, and it comes up when they don't want to think about it. Mostly, if you say, 'Don't think about a pink elephant or a white bear,' people flash onto it immediately."

Anderson likened the brain's ability to control memory to an individual's reflexive ability to halt an unwanted action. For example, Anderson recalled once standing at an open window and noticing a potted plant starting to fall. He quickly tried to catch the plant until he realized it was a cactus that could have injured him. "Our ability to stop action is so ubiquitous we don't know we're doing it," Anderson said. "This idea is that the neurobiological mechanism that we have evolved to control overt behavior might be recruited to control internal actions such as memory retrieval as well."

Anderson said the findings about the brain's ability to suppress memory could be used as a tool to better understand addiction and the ability of people to suppress unwanted thoughts related to craving. It might also help provide a model to assess individuals at risk from suffering post-traumatic stress disorder, he said.

In addition to Anderson and Gabrieli, the paper was written by Kevin N. Ochsner, a former Stanford postdoctoral fellow now at Columbia University; and other Stanford researchers including graduate student Brice Kuhl; social science research assistants Jeffrey Cooper and Elaine Robertson; science and engineering associate Susan W. Gabrieli; and radiology Professor Gary H. Glover. The research was supported by grants from the National Institute of Mental Health.

Source: Stanford University

