

San Francisco Chronicle

## Brain is built to forget, research says MRIs in Stanford study show active suppression of memories

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Friday, January 9, 2004

More than a century after Sigmund Freud's ideas first stirred controversy, they've won partial support from Stanford University laboratory experiments involving technology that was unimaginable in his time.



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One of Freud's key claims was that humans "repress" unpleasant **memories**. Such **memories** continue to lurk within the brain, and they occasionally resurface in disguised form -- say, in the eerie symbolism of dreams or in embarrassing "slips of the tongue," he argued. But skeptics have questioned whether such repression really occurs.

Now, using a technique called functional magnetic resonance imaging, or "fMRI" for short, researchers have caught human brain tissue in the act of suppressing simple **memories** in the form of paired words. The scientists report the findings in today's issue of the journal *Science*.

The findings suggest that despite the brain's astonishing ability to archive a lifetime of **memories**, one of its prime functions is, paradoxically, to forget.

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information, some of it unpleasant. We wouldn't get through the day -- or through life -- if we didn't repress much of it.

Previous research, mostly in animals, has uncovered brain systems for erasing unneeded **memories**, which helps keep circuits from overloading during early life.

The new results "confirm the existence of an active forgetting process and establish a neurobiological model for guiding inquiry into motivated (voluntary) forgetting," said the researchers, who included Stanford psychology Professor John D.E. Gabrieli.

In the Stanford experiments, 24 volunteers ages 19 to 31 began by memorizing word pairs such as "ordeal-roach," "steam-train" and "jaw-gum."

Then each volunteer lay down inside the ring-shaped fMRI scanner, located inside Stanford's Lucas Center for Magnetic Resonance Spectroscopy. Each volunteer gazed at words flashing on an overhead mirror, which reflected a computer screen. (They had to lie still for an hour to prevent blurring of the brain image.)

Initially, when a word appeared, such as "ordeal," the volunteer was expected to recall the word paired with it -- in this case, "roach." Later, though, volunteers were asked to try not to recall the second word -- in effect, to forget it.

Afterward, they were tested on their recall of all the word pairs. As it turned out, they had a harder time recalling the words they had previously endeavored to forget.

What's important, though, is what was going on inside their brains while they were lying inside the fMRI scanner and trying to forget words.

At such times, the brain regions previously suspected of repressing **memories** -- the left and right frontal cortex -- were more active (reflecting intensity of blood flow and oxygen consumption). Meanwhile, there was less activity in the hippocampus, which is involved in the remembering process. Typically, the best "forgetter" was one whose frontal cortex was most active.

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"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," Gabrieli said in a separate statement issued by Stanford. "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 lead author of the Science article is psychology Professor Michael Anderson of the University of Oregon, who conducted the experiment with Gabrieli and six other researchers: Kevin Ochsner, Brice Kuhl, Jeffrey Cooper, Elaine Robertson, Susan Gabrieli and Gary Glover. Except for Anderson and Kuhl, all team members during the experiment worked at Stanford. Ochsner has since moved to Columbia University.

Anderson speculates that the findings could encourage the development of new ways for people to overcome traumatizing **memories**. He is less optimistic, though, about the possibility of developing drugs or other lab techniques for expunging extremely complex **memories**, as in the recent movie "Paycheck," based on a Philip K. Dick story in which an evil computer company uses injections to erase its employees' **memories** of their inventions.

"It's possible in principle because your **memories** are implemented as physical changes (in the brain)," i.e. in the form of chemical and structural changes that could in theory be altered, Anderson acknowledges. However, extremely complex **memories** -- say, of a three-year period of one's life, as in the film -- are distributed throughout the brain rather than in single, easy-to-erase locales. Hence the total obliteration of such complex **memories** "is just so ridiculously complicated and improbable I don't think it could ever be done," Anderson said.

It's much too early to say whether the Stanford findings will prove useful in clinical psychoanalysis, the "lie down on the couch and tell me your dreams"-type therapy that peaked in popularity in the mid-20th century, inspiring innumerable New Yorker cartoons and Woody Allen jokes. Laboratory testing of the mental repression of words is one thing, while the study of repression of complex personal **memories** -- say, of child abuse -- is

likely to be much more difficult.

Still, the Stanford research is a promising start, so it's welcomed by Dr. Charles P. Fisher, a faculty member at the San Francisco Psychoanalytic Institute. "The Science article upholds one crucial piece of Freudian psychoanalysis -- the existence of motivated forgetting," Fisher says. "It also provides us with an important tool for future studies."

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### Areas of brain involved in controlling unwanted **memories**

Using functional magnetic resonance imaging, researchers determined the areas of the brain involved in the suppression of unwanted **memories**. These findings may have implications for the study of addiction and the ability of people to suppress unwanted thoughts related to craving, and in the assessment of people with post-traumatic stress disorder.

**Prefrontal cortex:** Significantly activated during suppression of unwanted **memories**; the findings indicate it exerts executive control over activity in the hippocampus.

**Hippocampus:** Part of brain responsible for memory; there was less activity here during attempts to shut out unwanted **memories**.

**Note:** Part of brain is shown removed to illustrate location of the hippocampus. The controlling of unwanted **memories** was associated with both the left and right frontal cortex.

Sources: Stanford University; the journal Science

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