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'Science' Showcases Research on Forgetting

Several months after the World Trade Center towers were destroyed, [Michael Anderson](#) sat in his living room enjoying the movie, "Working Girl." Set in New York City, the film featured a view of the World Trade Center towers in one key scene, and for Anderson, that brought back memories of 9/11. He found himself "clamping down on my thoughts, not wanting to think about the immense tragedy the towers represent."

The University of Oregon associate professor of psychology uses this personal example to illustrate how the mind attempts to rid itself of unwanted memories.

"Often in life we encounter reminders of things we'd rather not think about," Anderson explained. "We have all had that experience at some point--the experience of seeing something that reminds us of an unwanted memory, leading us to wince briefly, but just as quickly to put the recollection out of mind. How do human beings do this?"

Anderson said this process isn't restricted to memories as traumatic as 9/11, but is applied widely, to recollections pleasant and unpleasant.

"This active forgetting process is a basic mechanism we use to exclude any kind of distracting memory so we can better concentrate on the tasks at hand," he said. "For instance, it is quite disruptive to remember one's old PIN code at the bank when one needs to key in the new one." If we didn't have a way to suppress outdated information, we would be lost".

Active forgetting fascinates Anderson, and as one of the nation's leading memory researchers, he is shedding new light on how this process works in the brain.

Validating Repression

Anderson's latest findings, featured in the [Jan. 9 issue](#) of Science magazine, provide compelling evidence that Freud was on to something 100 years ago when he proposed the existence of a voluntary repression mechanism that pushes unwanted memories out of consciousness. Since then the idea of memory repression has been a vague and highly controversial idea, in part because it has been difficult to imagine how such a process could occur in the brain.

To mimic the brain's process in the lab, Anderson tested subjects using a procedure he devised. Subjects first learned pairs of words such as ordeal-roach, steam-train and jaw-gum. Then they were given the first member of each word pair by itself and asked either to think of the second word, or to suppress awareness of the second word.

Subjects performed this task while being scanned in an fMRI (functional magnetic resonance imaging) machine that produces computer images of brain tissue and function. From these

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images, researchers can determine which parts of the brain are in use for different tasks. After this phase was completed, Anderson tested the students' memory for all of the word pairs and confirmed that suppressing awareness of unwanted memories resulted in memory inhibition--that is, the more often people avoided thinking about the second word, the worse their memory for it became, replicating a finding he reported earlier in the journal, *Nature*.

The fMRI images of the subjects' brain activity during this procedure yielded astonishing results. This study revealed for the first time strong neurobiological evidence for a novel, yet simple idea about how memory repression occurs: Unwanted memories can be suppressed with brain machinery similar to that used when we try to stop overt physical actions.

Put simply, the brain systems (including a region known as the prefrontal cortex) that permit one to stop an arm motion midstream can be recruited to inhibit or stop the execution of an unwanted memory retrieval. Instead of inhibiting activity in brain regions having to do with physical action, however, these control processes reduce brain activation in the hippocampus, a structure known to be involved in storing conscious memories of the past. Crucially, this reduction in hippocampal activity led his subjects to forget the rejected experiences.

Letting the Cactus Fall

Anderson related the ability to control memory to the ability to control our physical actions. As an example, he recounted the time he knocked a plant off a windowsill at home.

"As I saw the plant falling off the sill out of the corner of my eye, I reflexively went to catch it. At the very last second, I stopped myself, midstream, when I realized that the plant was a cactus. I was very happy to have the ability to stop my actions, which is an ability so pervasive and indispensable that we don't even notice it in daily life."

Anderson's research indicates that stopping unwanted memory retrievals builds on the same brain mechanisms that help us to achieve this control over our overt behavior, providing a very specific and concrete mechanism that may demystify how repression occurs. His brain imaging results showed that he could predict how much forgetfulness subjects in his experiment would experience, simply by examining how active their **prefrontal cortex** was when attempting to suppress memories.

The UO researcher's neurobiological model for exploring motivated forgetting in the laboratory is a landmark achievement. Until now, the idea that unwanted memories can be repressed has been a controversial issue among psychologists. Anderson and his associates have helped experts get over this hurdle by providing a way to map and investigate these cognitive and brain process in the laboratory.

Among the immediate benefits may be the ability to better understand the cognitive and neural mechanisms by which people deal with the memory aftereffects of a traumatic experience and the breakdown of these mechanisms in post-traumatic stress disorder.

Anderson emphasized that future research is needed to examine the role of these mechanisms in suppressing emotional experiences, as the current study focused on the suppression of relatively neutral events. Nevertheless, they provide a well-grounded hypothesis for how some people may come to forget unwanted memories of unpleasant life experiences.

"To me what's most important is achieving a better understanding of how we learn to adapt

mental function in response to traumatic life experience," Anderson explained. "Survivors of natural disasters, crime, acts of terror such as 9/11 and the loss of someone close all undergo a process that may continue for a very long time--a process of learning to adjust both physically and mentally to those events."

"Now we have a specific neurobiological model of the mechanisms by which people normally adapt how their memories respond to the environment," he added. "My goal is to expand on this model so we can better understand these important experiences."

For more information:

- <http://darkwing.uoregon.edu/~blevy/lab/homepage.htm>
- <http://gablab.stanford.edu/>