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Controlling confusion: Researchers make insight into memory, forgetting

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Why do we forget? Do memories decay on their own, or are they harmed by interference from similar memories? Using a technique called "transcranial magnetic stimulation" (TMS), brain researchers at the University of Wisconsin-Madison may have found the answer.

Although the notion of decay makes sense, Brad Postle, assistant professor of psychology at UW-Madison, says it may be inaccurate.

"Psychologists have known for decades that the intuitive notion of decay is probably less of a factor in forgetting than is interference," he says. Interference occurs, he says, when "other remembered information disrupts, competes with or confuses the information that you want to remember."

Interference is always present, Postle says, but we don't always notice it.

"An obvious case is like yesterday, when a friend was telling me his cell phone number but actually gave me his home phone number," he says. Another scenario is equally familiar: We get most details of the story right, but misidentify the source. Or we remember that the quotation comes from Shakespeare, but we name the wrong play.

"Interference is also often to blame," says Postle, "in cases when we simply can't remember something."

If blocking interference is so important to a good memory, where — and

how — does that blocking occur? In a study published in the *Proceedings of the National Academy of Sciences* this week (Dec. 4) Postle — together with Giulio Tononi, of the UW-Madison School of Medicine and Public Health, and Eva Federoes, a researcher in the UW-Madison Department of Psychology — studied how part of the brain's prefrontal cortex can reduce the disruptive effects of interference. The prefrontal cortex is responsible for complex thought.

From brain scans, scientists already knew that the subregion under study, called the inferior frontal gyrus, or IFG, is active when volunteers take memory tests while confronting interference. But was the IFG essential to controlling interference, or was it just contributing more brain horsepower to complex memory tasks?

To answer that question, the researchers temporarily disrupted the IFG using TMS, a noninvasive technique that shows potential for treating depression and other disorders.

"TMS is a technique that allows the induction of a current in the brain using a magnetic field that passes through the scalp and the skull safely and painlessly," says Tononi, a pioneer in refining the technique for brain research. "TMS can be used to briefly 'scramble' neural activity in the underlying brain area for a short time, typically a second or so. This scrambling is fully reversible, and after the pulsing, the targeted brain area becomes fully functional again."

Neuroscientists have traditionally identified the roles of particular parts of the brain by studying people with brain injury. TMS allows them to do a similar study on healthy volunteers, Tononi says.

"The great advantage for researchers," he says, "is that one can test whether a given brain area is causally involved in producing a given behavior, but as soon as the current is turned off, the brain returns to

normal."

In the current study, volunteers read a group of letters (F, B, P, X) and were asked a few seconds later whether a particular letter had appeared in the most recent group ("Did you just see a 'Z'?"). In this type of test, having seen a "Z" in the string-before-last causes interference that makes the task more difficult. The subjects take longer to respond, and are more likely to incorrectly say "yes."

The research setup was designed to be a simplified version of many everyday memory challenges, says Postle. Without a good sorting mechanism, our brains would be utterly confused by the vast amount of observations, ideas and memories that we have stored away. We might, for example, dial the phone number of the friend we just called rather than the one we intended to call.

In previous studies of interference, the IFG consistently lit up in brain scans, showing that it does something when the memory tries to deal with interference. But the IFG could simply be contributing some type of generic processing power to the task, says Postle.

However, the new study proved that the IFG is essential to blocking interference, he says, because accuracy plummeted when the IFG got a brief jolt of magnetic stimulation at the exact moment when the subject was confronting confusion.

Postle hopes that eventually, locating the site of specific memory operations in the brain may help the millions of people with declining memories. "Understanding how the brain controls interference may be a first step to helping people with memory problems," he says.

The precise system used to target the magnetic pulse has many other applications in neuroscience research and treatment, Tononi adds.

"TMS can be used not only to disrupt brain activity, but also to change it. If applied repeatedly, TMS can strengthen certain circuits that have become pathologically weak," he says.

TMS is already being tested to treat severe depression, one of the most serious psychiatric illnesses. In studying this treatment, he adds, "It is important to be able to target TMS exactly to the right area for each individual brain, just as we did in this study."

Source: University of Wisconsin-Madison