Oh, Darn It!

UM Professors Investigate How the Brain Reacts to Mistakes

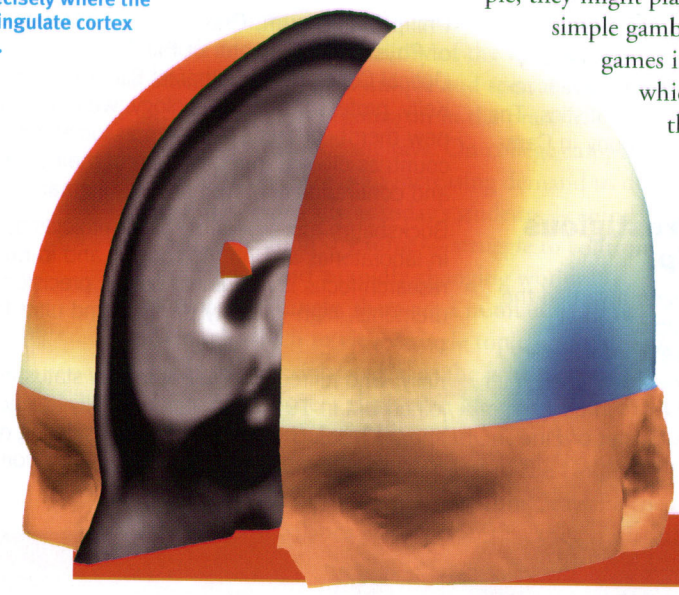
by Lara Magouirk

No one's perfect. Mistakes, goofs, and errors are a natural part of being human. But how does the brain react when we screw up — whether it's taking the wrong exit on the freeway, locking ourselves out of the house, or tripping up the steps on the way into the office?

William Gehring, Arthur F. Thurnau Professor of Psychology, is attempting to answer that question through research examining how the brain knows when mistakes occur.

His research has identified an early warning system in the brain — Gehring describes it as a brain wave — that is activated when people make mistakes. "The brain wave is actually electrical activity generated by the anterior cingulate cortex, a part of the brain just behind the forehead," says Gehring. "The electrical activity signals that something bad has happened and clues us in to do something about it."

The technical term for Gehring's brain wave is "error-related negativity," or ERN, although people have also given it informal labels like the "Oh, darn it!" response. To record the ERN, Gehring asks subjects in his studies to wear caps wired with sensors that record minute fluctuations in electrical activity. The brain produces these minute fluctuations when it processes information. Gehring's subjects perform tasks specifically designed to cause errors; for example, they might play simple gambling games in which they occasionally lose money. When test subjects make a mistake, a voltage spike is recorded in the brain wave.



This computer-generated model of brain activity shows precisely where the anterior cingulate cortex is located.

Courtesy of William Gehring

Still, no one's really sure what the brain is actually doing when it generates ERN. Several laboratories around the world are studying the phenomenon, and many researchers have their own theories. Some investigators think ERN is generated when the brain makes a comparison between what one is doing and what one should be doing. Gehring, however, thinks ERN is part of a general-purpose trouble-detection system that signals not only when someone makes a mistake, but also when generally "bad" events occur.

Gehring is collaborating with colleagues in the Department of Psychiatry and in the Department of Psychology to use ERN to understand real-world issues, since a number of psychiatric disorders are thought to involve dysfunctions in the anterior cingulate cortex. Gehring says that a better understanding of such disorders can lead to advances in treatment.

One such example is obsessive-compulsive disorder (OCD). Individuals with OCD experience persistent, unwanted thoughts known as obsessions — for example, the thought that one's hands are dirty. They then perform repetitive ritualistic behaviors, known as compulsions, which are often related to the obsessions.

Gehring's work has shown that people with OCD have exaggerated ERN activity.

This finding supports a theory that individuals with OCD experience obsessions and perform compulsions at least because their brains are constantly signaling that something is wrong. Gehring and his colleagues are following up on this finding in several new studies, one of which will use the ERN to help determine how OCD develops in children.

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