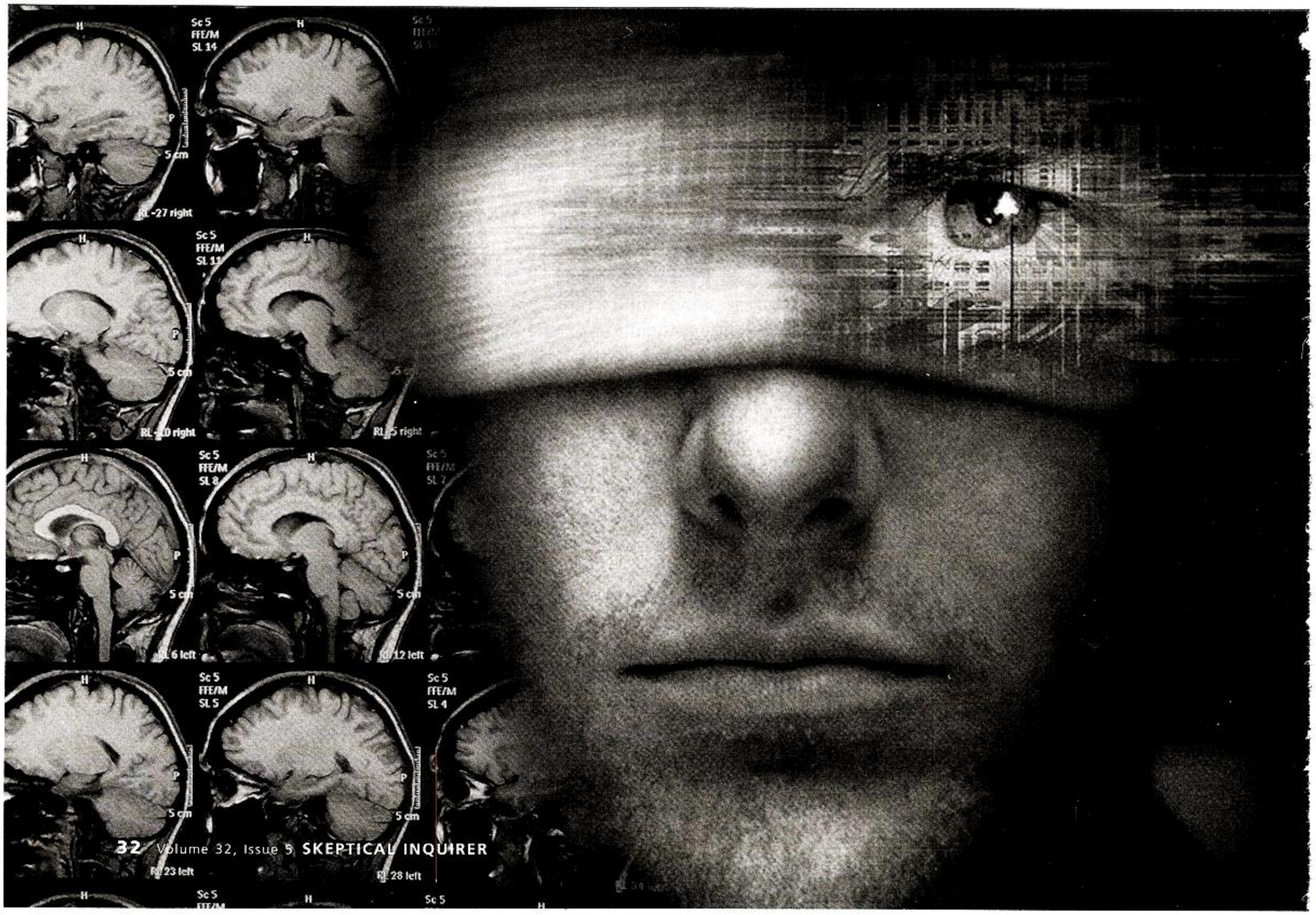
The Truth About Brain Science

There's enormous excitement these days about brain science, and well there should be. More precise scanning technologies are now letting scientists monitor brain activity in real time while people are actually behaving and thinking; historically, that's something quite new. As exciting as this is, however, I'm concerned about the hype. Claims are being made about brain research that just aren't true, and they're being accepted uncritically by the press, the public, policy makers, and even the courts.

Robert Epstein, PhD, is former editor-in-chief of Psychology Today, *contributing editor for* Scientific American Mind, *and visiting scholar at the University of California San Diego. This is the first of a new occasional SI column titled "The Skeptical Psychologist." He can be reached at repstein@post.harvard.edu.*

Before I get to my concerns, let's take a quick look at recent advances, because they truly are remarkable. Take something simple such as brain size. Before the new scanning techniques were available, if you wanted to know the size of a person's brain, you had to wait until he or she died. This is still true for Alzheimer's disease; the only way to confirm the diagnosis is through examination of a dead brain. In that sense, all diagnoses of Alzheimer's are tentative—a problem that will undoubtedly be solved soon by new diagnostic techniques.

So for generations, information about brain size was based on how brains looked in dead bodies. That's far from satisfactory, because dead brains often swell or shrink, depending on the cause of death. Just a



few years ago, researcher Eric Courchesne (2000) and his colleagues at the University of California San Diego decided to look at how the size of people's brains changes with age. Instead of looking at dead bodies, however, they used MRI technology to measure the brains of living subjects. The result was dramatic: it turns out that our brains are very small when we're babies, grow throughout childhood, reach their maximum size at about age fourteen, and then gradually shrink for the rest of our lives. At age seventy, our brain has shrunk to the size it was when we were about three. This pattern closely matches changes in cognitive abilities across the lifespan, especially changes in intelligence and memory. Before the scanning study was done, this developmental pattern in brain size was hard to see, even though it's quite distinct.

Brain size is simple fare, but some recent brain-scanning studies border on science fiction. Recently, John-Dylan Haynes (2007) and his colleagues at the Max Planck Institute in Germany used CT-imaging technology to predict what people were going to do seconds before they did it. Subjects were told to decide whether they were going to add or subtract two numbers that would shortly flash on a screen—and to keep their decision a secret. By focusing on activity in the prefrontal cortex of the brain, Haynes could predict with 70 percent accuracy which calculation the subjects would perform.

Similar technology is now allowing a few paralyzed individuals to control devices with their thoughts. This suggests a future that is not only better for those who are impaired, but one which will allow the rest of us to interface with devices—and, ultimately, with each other—just by directing our thinking in certain ways—in effect, through what will feel like "intention" or "will."

I could go on, but let's get to my concerns. There is currently *so much* excitement about brain research that many current findings are being blatantly misinterpreted. The vast majority of brain studies being conducted these days are correlational, which means they simply identify a correspondence between behavior (or emotions or thoughts) and what the brain is doing when someone is behaving (or feeling or thinking). When people who are in love think about their loved ones, for example, the ventral tegmental area of the brain lights up—the same area that lights up when people are high on cocaine.

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Many of these correlational studies don't even look at the correlation in real time. They just make assumptions that may or may not be true and go from there. For example, differences in the brain activity of teens and adults are now said by some researchers to explain why teens are inherently irresponsible or lazy—even in studies in which the teenage subjects were never shown to be irresponsible or lazy (Bjork et al. 2004). The fact that teens in more than one hundred cultures around the world exhibit none of the turmoil we see in American teens is conveniently being ignored by brain researchers right now. They're simply connecting the results of brain-scanning studies to faulty assumptions about teen abilities, and their flawed claims have been accepted uncritically by the media and even by the U.S. Supreme Court (Epstein 2007). Legal scholar Stephen Morse's 2006 essay on what he calls the "brain overclaim syndrome" raises concerns about the naiveté of the courts in such matters. In 2007, the MacArthur Foundation launched its ambitious Law and Neuroscience Project to try to address the problem.

Overinterpreting correlational brain studies is a big mistake, explains retired brain scientist Elliot Valenstein clearly and at length in his book *Blaming the Brain* (1998). Correlational studies tell us nothing about causation. If people who are in love show certain brain characteristics, that doesn't mean that those brain characteristics cause feelings of love. In fact, it's more than likely that contact with their lovers is producing *both* those feelings of love *and* certain changes in the brain.

Although it's true that changes in the brain can affect behavior and emotion, it's also true that behavior, feelings, and environmental events change the brain. When we exercise, smoke, take medication, learn, or experience trauma, our brains are altered. When women are raped or soldiers witness atrocities, their brains are changed. When we lose a loved one, our brains are changed, often resulting in depression.

The problem with many headlines these days is that they automatically claim, based on the latest correlational brain study, that we have identified the *cause* of depression or love or autism or Alzheimer's just because some area of the brain lights up when people have that condition. But finding correlations isn't the same as finding causes, and finding causes is often quite difficult.

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