

PSYCHOLOGY

Out-of-Body Experiences Enter the Laboratory

Out-of-body experiences are associated more with tabloid newspapers, New Age Web sites, and large doses of hallucinogenic drugs than serious scientific discussion. Yet they're often reported by reputable people who suffer from migraine headaches, epilepsy, and other neurological conditions. Intrigued by such accounts, some researchers are trying to figure out how the brain creates an aspect of human consciousness so fundamental that we take it for granted: the perception that the "self" conforms to the borders of the physical body.

Now, two teams of cognitive neuroscientists independently report on pages

1048 and 1096 methods for inducing elements of an out-of-body experience in healthy volunteers. Both groups used head-mounted video displays to give people a different perspective on their own bodies. Each team also drew upon the sense of touch to enhance the illusion. Although details of the experience differed, the people in both experiments reported feelings of dissociation from



Where am I? Swiss researchers used a video camera to give people wearing display goggles the feeling they inhabited a virtual body (right) in front of their real location.

their bodies. The researchers say their findings will pave the way to new brain-imaging studies of body perception and could have practical applications, such as helping virtual-reality programmers design environments that make users feel as if they are really *there*.

"It's striking because when you hear about out-of-body experiences, it sounds so deeply weird," says Chris Frith, a cognitive

neuroscientist at University College London who did not participate in the new research. "These studies show you can actually manipulate it experimentally." The illusions add to evidence that the brain's representation of the physical body is malleable and can be modified by information from the senses, Frith says.

For one of the studies, a team led by Bigna Lenggenhager and Olaf Blanke, both of the Swiss Federal Institute of Technology in Lausanne, asked people to stand in front of a camera while wearing video-display goggles. In one experiment, subjects saw the camera's view of their

own back, computer-enhanced to create a three-dimensional "virtual own body." When the subjects' backs were stroked with a highlighter pen at the same time they saw their virtual back being stroked, they reported that the sensation seemed to be caused by the highlighter on their virtual back, making them feel as if the virtual body was in fact their own body.

Moreover, when the researchers turned ▶

GENETICS

Epidemiologist Sees Flaws in Papers on Genes and Gender

An epidemiologist who for years has critiqued the veracity of published papers has now tackled a hot area in genomics, sex-based genetic differences. He argues that most reported findings are poorly documented and that about a sixth may actually be wrong.

As researchers move beyond uncovering new disease genes and into the realm of gene-environment interactions, John Ioannidis, a clinical and molecular epidemiologist at the University of Ioannina School of Medicine in Greece, decided to follow them. He wondered especially about genetic associations with diseases that seem to vary by gender—for example, a particular gene variant that confers increased risk in women but not in men, an effect that may be modulated by hormones. Hundreds of such associations have been reported. But when Ioannidis and

two colleagues analyzed data from 77 papers covering everything from multiple sclerosis to lung cancer to anger, they found that 19 had at least one claim they judged to be "spurious," or apparently incorrect. Only four papers contained neither spurious nor insufficiently documented claims, says Ioannidis.

He and his colleagues searched online for papers whose titles touted gender variation in gene effects, then examined each claim (a total of 432 sex-difference claims in the 77 papers). To determine whether claims were spurious, they considered the groups being compared—for example, older men and older women, which would be appropriate, or older men and younger women, which would not. They looked for evidence in the paper that claims reached statistical signifi-

cance. Those without were judged not sufficiently documented. The analysis was published in the 22/29 August issue of the *Journal of the American Medical Association*.

Of the gene-gender findings, says Ioannidis, "there is a problem with just accepting them and believing that they're true." Proper documentation was found in only 55 claims, or 13% of the total.

The Ioannidis paper reinforces concerns about the quality of published genetics results, says Neil Risch, a genetic epidemiologist at the University of California, San Francisco. Still, he defends some findings in the field, such as a greater risk for women with an Alzheimer's gene and a greater risk for males who carry a gene variant linked to rheumatoid arthritis. The Ioannidis analysis did not pick up

CREDIT: OLAF BLANKE/LABORATORY OF COGNITIVE NEUROSCIENCE (EPFL)

Downloaded from www.sciencemag.org on August 23, 2007

off the video display, guided the subjects back a few steps, and then asked them to blindly return to their former position, subjects overshot the spot where they'd actually been standing and walked to a point closer to the apparent location of their virtual body.

Adopting a similar strategy to attempt to induce out-of-body experiences, Henrik Ehrsson of the Karolinska Institute in Stockholm, Sweden, asked men and women to sit in a chair and don a video headset connected to two cameras that provided a stereoscopic view of their backs. As a subject viewed his or her own back from behind, Ehrsson used two plastic rods to simultaneously stroke the subject's chest and a location behind the subject's back. Although people felt the rubbing on their chest, in the headset they could only see Ehrsson's arm moving behind their back, reinforcing the sense that they were sitting at a location behind their actual body. The experience often elicited surprised giggles, says Ehrsson, who has tried it out himself. "You really feel that you are sitting in a different place in the room and you're looking at this thing in front of you that looks like yourself and you know it's yourself but it doesn't feel like yourself," he says. "It's almost like you're looking at a dummy." Nearly all subjects reported similar impressions on a questionnaire.

Ehrsson also repeated the illusion with electrodes attached to each person's fingers to measure skin conductance, a physiologi-

cal measure of emotional arousal. Then he swung a hammer in front of the cameras so that it appeared to hit the region where people perceived themselves to be. The hammer posed no physical danger, but changes in skin conductance indicated that subjects registered a threat (they also reported feeling anxious). By showing that people respond emotionally as if they were located at a position behind their physical body, the findings provide additional evidence that the subjects buy into the illusion, Ehrsson says.

Both experiments show that visual perspective and coordination between the senses of vision and touch are important for the sensation of being within the body, says Peter Brugger, a neuroscientist at University Hospital Zürich in Switzerland. Yet neither study replicated the full-blown out-of-body experiences in which people report "an enormously compelling sensation of separation from the body," he notes. Even so, Brugger says, these illusions may be as close as it is possible to get in the lab.

Previous research has pointed to several brain regions, including the intersection of the temporal and parietal lobes, that may be involved in producing out-of-body experiences in neurological patients, Blanke says. The new illusions can be used to examine which of these brain regions contribute to which aspects of these strange experiences, and that in turn, says Blanke, could lead to a better understanding of how the brain generates a concept of self. **—GREG MILLER**

these papers in its literature search because it netted only those with "polymorphism" and either "sex" or "gender" in the title.

Some scientists whose papers Ioannidis has critiqued agree that it's difficult to know

"There is a problem with just accepting [the claims] and believing that they're true."

**—John Ioannidis,
University of Ioannina**

whether a finding will hold until it's been replicated. "Admittedly, the strength of an observation such as ours lies not only with the experimental design, but with the ability of other investigators to reproduce the observation," wrote Judith Miller, a kidney disease specialist at the University of Toronto, Canada, in an e-mail. David Christiani,

an epidemiologist at Harvard School of Public Health in Boston, agreed in an e-mail that his 2004 study in *Chest* on acute respiratory distress syndrome had limited statistical power but added that this was noted in the paper.

Ioannidis, however, thinks that researchers need to do a much better job of stating the limits of their findings. "The papers should have been published," he says, noting that "nothing is perfect." But "better transparency" is sorely needed.

"People make claims from their data that just are not there," agrees Kathleen Merikangas of the National Institute of Mental Health in Bethesda, Maryland. Contributing to the problem, she says, is that many studies that fail to replicate a genetic finding are never published because they're "not new and exciting, or the scientists themselves don't find that it's going to advance their career." **—JENNIFER COUZIN**

Time Out for Institute Leader

A large number of scientists at the National Institute of Environmental Health Sciences (NIEHS) have turned against their embattled director. Of 146 staff scientists who responded to a survey by NIEHS's Assembly of Scientists, 107 said they did not have confidence in David Schwartz's leadership. This week, Schwartz (below) stepped down temporarily as the National Institutes of Health (NIH) launched a sweeping management review of the \$642-million-a-year institute in Research Triangle Park, North Carolina. NIH Director Elias Zerhouni said that the review is in response to congressional inquiries, which have included Schwartz's management of his personal lab, his consulting for law firms, and his handling of NIEHS's journal (*Science*, 6 July, p. 26).



Senator Charles Grassley (R-IA) wrote Zerhouni this week to ask why some NIEHS employees had recently been given a form for logging calls received from congressional investigators. The form could intimidate potential whistleblowers, which would be "not only wrong but also illegal," Grassley says.

—JOCELYN KAISER

U.S. Targets Add-On Patents

In an effort to streamline its operations, the U.S. Patent and Trademark office is clamping down on how often applicants can tweak their inventions. Last year, 30% of all patent filings were continuations, in which inventors add details to a pending application. So this week, after 18 months of wrangling with the community, the office decided to limit such filings to two per patent, with petitions required for further continuations.

Biotech companies oppose the new limits, which they believe will deprive the patent office of information that could strengthen applications, including results from ongoing work. But lawyer Peter Zura of Bell, Boyd & Lloyd LLP in Chicago, Illinois, thinks the changes are not an "end-of-the-world thing" because firms that write biotech patent applications, including his own, will devise ways to protect their proposed inventions, such as more rigorously constructing original applications. But "it's definitely going to make life more difficult," he says.

—ELI KINTISCH