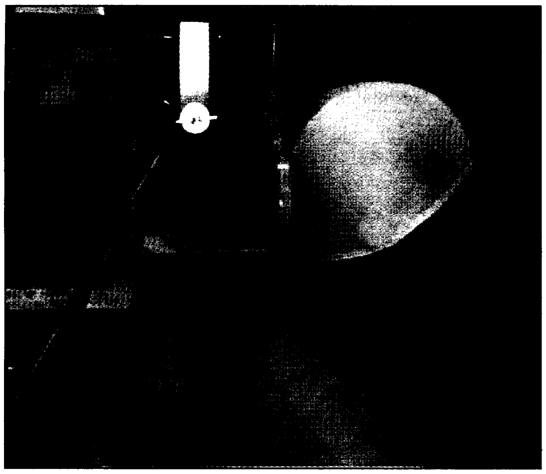
NEUROBIOLOGY

Shedding Light on Visual Imagination

In the past decade, two little acronyms, PET and fMRI, for positron emission tomography and functional magnetic resonance imaging, have permeated the literature of cognitive neuroscience. That's because these powerful techniques allow researchers to see activity in the living human brain. But both have a drawback: Although they can show a correlation between brain activity and a given function, they can't show a causal connection. Now a relatively new, little-known technique called transcranial magnetic stimulation (TMS) may provide that missing link.



Brain zapper. This TMS device focuses a magnetic field that disrupts specific brain areas.

CREDIT: A. PASCUAL-LEONE, BETH ISRAEL DEACONESS MEDICAL CENTER

On page 167, Stephen Kosslyn and his colleagues at Harvard Medical School report that they have used TMS, which directs a magnetic field to temporarily disrupt the functions of specific brain areas, to address a decades-old question in cognitive psychology: Does the visual imagery that occurs when the brain imagines an image work the same way as when the brain processes a real image from the retinas? Their results support the hypothesis that it does, because they indicate that the primary visual cortex, the first part of the cerebral cortex to receive retinal information, is necessary for at least some visual imagery as well.

"This is a very exciting finding," says cognitive neuroscientist Randy Buckner of Washington University in St. Louis—and not just for its contribution to the imagery debate. If TMS works as it seems to, he adds, it is "exactly what the field needs, an ability to safely manipulate cognitive processing in humans," partially inactivating brain areas to help pin down their functions.

Kosslyn began exploring the brain's strategies for imagining—as opposed to viewing—a scene more than 20 years ago. In his early experiments, he measured the time it took people to shift their attention from one feature in an imagined scene to another. That time grew with the distance between the features, suggesting, but not proving, that the brain was panning across an imagined scene, depicted in the brain with the same spatial topography as a retinal image.

When brain imaging techniques became available, they provided further support for that idea. V1, the primary visual cortex, is "retinotopically organized," which means that it encodes images in a way that preserves the same spatial arrangement that falls on the retinas. In 1995, Kosslyn and Nathaniel Alpert at Massachusetts General Hospital in Boston used PET to show that visual imagery activates V1. They also showed that changing the size of the imagined image changes the area of activation in V1, further evidence that the image is represented retinotopically.

But the possibility remained that V1 activation was merely a side effect and that some other brain area actually produces visual imagery. To address that issue, Kosslyn teamed up with Alvaro Pascual-Leone of Boston's Beth Israel Deaconess Medical Center to try TMS, which works by focusing a magnetic field on targeted brain areas, inducing electrical currents that temporarily disrupt their functions.

The technique has been used for years for mapping brain areas responsible for movement, and in 1997, Pascual-Leone, working with Leonardo Cohen and Mark Hallett of the National Institute of Neurological Disorders and Stroke (NINDS), used TMS to show that V1 plays a role in Braille reading. In that study, TMS was delivered as a rapid barrage, and the subjects were tested during the stimulation. But high-frequency TMS has on rare occasions caused seizures, and Pascual-Leone also worried that magnetic stimulation during testing may generally disrupt attention, casting doubt on the role of brain areas such as V1. A recent study showed, however, that the effects of safer low-frequency TMS on the motor cortex linger for up to 10 minutes. So Pascual-Leone and Kosslyn applied low-frequency TMS to V1, turned it off, and then tested the subjects.

After treating eight subjects, they had them compare the lengths of pictured bars, either while looking at the picture or while holding its image in memory. TMS impaired the subjects' abilities at both perception and imagery when compared to a sham treatment that focused the magnetic field outside the brain, creating the same scalp sensations as real TMS without affecting any brain areas.

"Their effect looks very strong," says neurologist Eric Wassermann of NINDS. He cautions, however, that the effects of low-frequency TMS are even less well understood than those of the high-frequency form used in the Braille study, and warns that the team has not ruled out the same concern Pascual-Leone had for high-frequency TMS—that it may cause a general disruption of brain function.

Others, including cognitive neuroscientist Nancy Kanwisher of the Massachusetts Institute of Technology, question the technique's ability to uniquely pinpoint V1. It is likely to be affecting adjacent visual areas as well, says Kanwisher. But she adds, "I don't think that matters," as those areas are also retinotopically organized. "The point is being able to say 'There is the image, and it is in the retinotopic cortex.' "

Some skeptics don't agree. Zenon Pylyshyn of Rutgers University in New Brunswick, New Jersey, has maintained for decades that visual imagery is encoded not spatially but in what he calls "the language of thought, a symbolic language." Even if disrupting V1 reduces performance, he argues, "that still doesn't show that the retinotopic aspect of V1 is being used." Instead, he says, V1 may encode information in non-retinotopic ways as well. But even if this result doesn't finally settle the imagery debate, it may foreshadow a time when TMS—if its safe form proves reliable—will be as familiar a tool for cognitive neuroscientists as PET and fMRI.

–MARCIA BARINAGA

ZOOLOGY

Dispute Over a Legendary Fish

It must have been like spotting a koala in New York's Central Park. Strolling in a fish market on the island of Sulawesi, Indonesia, in September 1997, Mark Erdmann, a biologist at the University of California (UC), Berkeley, and his wife Arnaz caught a glimpse of what appeared to be a coelacanth, just before the hefty lobe-finned fish was whisked away by a buyer. Almost 60 years had passed since the stunning news that a coelacanth—a species believed to have gone extinct 80 million years ago—had turned up off South Africa, 10,000 kilometers from Indonesia. No one thought the living fossil survived anywhere else in the world until Erdmann, almost a year after the initial sighting, at last laid his hands on a live specimen. Now it turns out that Erdmann's find may be not just another coelacanth but a second coelacanth species.

Erdmann, however, isn't celebrating the announcement, because the report in the April issue of *Contes Rendus de L'Académie* *de Sciences*, published by the French Academy of Sciences, comes not from his group but from geneticist Laurent Pouyaud of the French Institute for Development Research (IRD) in Jakarta and colleagues at the Indonesian Institute of Sciences (LIPI) in Cibinong. Erdmann calls the preemptive strike a "dishonorable act of scientific piracy"; Pouyaud says it was aboveboard.

Erdmann, who studies shrimps, was no expert in coelacanths when he moved to Indonesia in 1991. But he is an expert now. After spotting the fish, Erdmann spent the next 10 months interviewing fishers, monitoring catches, and gathering temperature and depth data from fishing sites in an attempt to track down another specimen. He finally succeeded in July 1998 and last September published a report in *Nature* describing the find.

After taking some tissue samples, Erdmann donated the fish to LIPI. But he claims that in an oral "gentleman's agreement" LIPI had agreed that a team led by David Hillis of the University of Texas (UT), Austin, to whom Erdmann had provided samples, would be the first to publish an analysis of the fish's DNA, after which the LIPI scientists could name the new species—if that's what the Indonesian coelacanth turned out to be. Shortly thereafter, LIPI scientists got Pouyaud, who is advising the Indonesian government on aquaculture, to help them with their own analysis. Pouyaud submitted a report to *Nature* last January, just days after the UT group's analysis arrived at the journal (where it is still under review). In February *Nature* rejected the paper from Pouyaud, who then offered a revised version to the *Contes Rendus*, which published it a month later.

New species? Scientists are embroiled in a dispute over the Indonesian coelacanth.

Based on an analysis of two swatches of mitochondrial DNA, which is thought to accrue mutations at a regular pace and thus can be used to time how long two populations have been evolving separately, Pouyaud and his group report that the Indonesian coelacanths diverged from their African cousin, *Latimeria chalumnae*, between 1.2 million and 1.5 million years ago. The genetic and morphological distinctions between the two populations are great enough to merit classifying the Indonesian coelacanth as a new species, they conclude, naming it *L. menadoensis*, after the volcanic island, Manado Tua, where the fish was found. "We have not only found a new population of coelacanths but a new species," Pouyaud told *The London Sunday Times* on 28 March. In a commentary accompanying the *Contes Rendus* report, evolutionary biologist Claude Combes of the University of Perpignan in France agrees that the Indonesian specimen falls "outside the range of measures ... of the Comorian specimens." The naming of a new species "appears justified," he writes.

The Hillis team doesn't go that far. From their analysis of mitochondrial DNA they conclude that the two coelacanth populations began diverging earlier, around 5 million to 7 million years ago. "We think it is a new species," says UC Berkeley's Roy L. Caldwell, a co-author. However, he adds, "we did not name it. ... We feel it's premature to name a new species based on one specimen."

But the fine points of speciation aren't the issue here. "We were unaware there was any other study going on," says Hillis. "The whole publication process apparently involved stealth and subterfuge." LIPI scientists could not be reached for comment. But Erdmann says several LIPI co-authors of the paper told him that "Pouyaud went ahead without their consent." He adds that he would not have complained if the Indonesians had named the fish. But he is outraged that Pouyaud stands to get the lion's share of credit. "All this guy did was stick some meat in a sequencer," Erdmann says. According to Susan Jewett, an ichthyologist at the Smithsonian Institution in Washington, D.C., "for somebody to move in on such a high-profile thing, where everybody knew who all the key players were, is highly unethical."

Pouyaud calls Erdmann's distress sour grapes. "Two scientific research teams were competing," he told *Science*. "At the end, little David beat Goliath." He adds that his group's *Nature* submission contained only the genetic analysis. Senior French scientists, he says, "urged us ... to name the species" in the paper for *Contes Rendus*. Pouyaud's employer is squarely behind him. "We know nothing about any agreement between Dr. Erdmann and the rightful owners of the specimen" at LIPI, says IRD's Patrice Cayre. "LIPI has every right to do whatever it wants with the specimen."

—CONSTANCE HOLDEN

CREDITS: (TOP)SAM KITTNER; (BOTTOM) LAURENT POUYAUD

ScienceScope

Cold War Antidote Russian Prime Minister Evgeny Primakov boycotted a biannual rap session with Vice President Al Gore last week to protest the NATO bombing of Yugoslavia, but his absence didn't stop officials from the two countries from finalizing an agreement to exempt joint research from Russian taxes.

Tithes on scientific equipment imported to Russia have riled both sides. "Once in awhile supplies are confiscated and held for ransom," says a U.S. participant in last week's Gore-Primakov Commission meeting. The border troubles delay projects and force Russian scientists to pay duties or bribes. The new agreement—in principle—should eliminate the problem.

Also laid at the meeting were tentative plans to expand cooperation on emerging disease surveillance, supercomputer research, and high-energy physics. However, a U.S. overture for more bilateral Arctic research got a chilly reception.

No Contest Scientists opposing a controversial data-access proposal appear to be headed for a lopsided win in an unusual skirmish—even as their opponents are raffling off prizes to gain allies.

Acting on legislation pushed by Senator Richard Shelby (R–AL), the White House Office of Management and Budget (OMB) in January released a controversial proposal to require taxpayer-funded researchers to hand over their raw data to anyone who files a request (*Science*, 12 February, p. 914). The agency gave the public until 5 April to comment, sparking a furious letter-writing campaign both for and against the proposal. Last month, rule opponents—including most scientific societies—were alarmed to discover that the other side was ahead in the comment contest, in part because it was offering a creative incentive: People who used the Junk Science Web page (www.junkscience.com) to write to OMB could win a subscription to an environmental policy newsletter or the electronic *Wall Street Journal*. But the tide has turned in the last few weeks: The 1600-and-counting comments OMB has received so far are running 4 to 1 against the rule, says the Washington-based American Association of Universities. Whether the landslide will persuade OMB to rewrite the proposal, however, won't be known until later this year, when it must finalize the rule.