

# SCIENTIFIC AMERICAN **MIND**

THOUGHT • IDEAS • BRAIN SCIENCE

February/March 2007

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# SCIENTIFIC AMERICAN MIND

THOUGHT • IDEAS • BRAIN SCIENCE

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## Nervy Sex Appeal

“67-year-old dissatisfied flâneur picking my toothless way through the urban sprawl, self-destructive, sliding towards pathos, jacked up on Viagra and on the lookout for a contortionist who plays the trumpet.”

No surprises there. Romantic hopefuls in the *London Review of Books* personals drolly dis themselves routinely, boasting that they are, among other things, older than 100, infertile, flatulent, “big-boned” and look like “Hervé Villechaize and carry an odour of wheat.” David Rose of the *London Review* collected gems such as the one above in *They Call Me Naughty Lola* (Scribner, 2006).

Such humble notices starkly contrast the superhero-like self-portraits in online dating venues, where every woman seems to be attractive, fit and 29 and each man is wealthy, tall and toned. But all lovelorn writers share a goal: telegraphing their worth (whether by self-abasement or by self-promotion) to potential partners. In his article “The Truth about Online Dating,” psychologist Robert Epstein takes a look at what modern courting reveals about us. Turn to page 28.

Delving deeper into the mysteries of our unconscious longings, neuroscientist R. Douglas Fields writes of a little-known cranial nerve that may provide a signaling link for subliminal sexual attraction. In “Sex and the Secret Nerve,” starting on page 20, he reveals the intriguing findings about cranial nerve zero.

Most people would say that finding love is a key to greater happiness, along with achievements like a bigger home, a better car, more money and fame. But research suggests none of these things is likely to increase bliss significantly. “Why It’s So Hard to Be Happy,” by psychologist Michael Wiederman, tells how ancient humans’ perpetual search for a better life—historically, a survival advantage—can now leave us dissatisfied despite the comforts of today’s world. Learn more beginning on page 36. One lesson is that “happy people tend to engage in activities that are challenging and absorbing”—such as reading articles in *Scientific American Mind*. Okay, I slipped in that last part. Happy now?

Mariette DiChristina  
Executive Editor  
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COVER IMAGE BY JEAN-FRANCOIS PODEVIN

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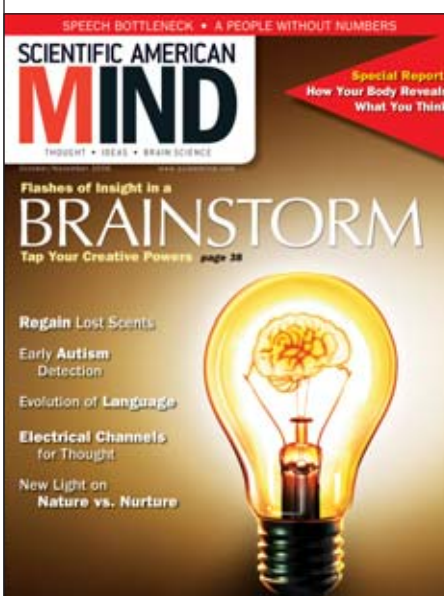
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## CREATIVE SPARKS

I enjoyed reading “The Eureka Moment,” by Guenther Knoblich and Michael Oellinger. The authors give a puzzle (“Puzzle Two”) with the objective of having readers calculate the combined area of a square and a parallelogram. The solution given (that is, treating the figure as two overlapping triangles) is creative. But I am not certain of its advantage over standard geometric computation.

We are told that the figures are a parallelogram and a square. The formula for the area of a parallelogram is the product of the length of the base and the (perpendicular) height. A glance at the diagram shows  $b$  to be the length corresponding to one side of the square plus the length of the base of the parallelogram, so the length of the base is clearly  $b - a$ . The height of the parallelogram is already labeled  $a$ , so that makes the area of the parallelogram  $a(b - a)$  or  $ab - a^2$ . The area of the square is of course the second power of the length of a side  $a$ , so it is  $a^2$ . Summing these two areas gives  $ab - a^2 + a^2$ , which is equal to  $ab$ , the desired answer.

These two geometric formulas are within the proficiency of secondary school mathematics, and the few algebraic computations can be quite easily performed without the aid of paper and pencil. I realize that this “high

school method” may not be as glamorous or creative as the one the authors propose, but sometimes the old ways are just as good as the new ones.

Deepak Mitra  
via e-mail

“The Eureka Moment” contains a frequently made mistake concerning the connections between the eyes and the brain hemispheres. It is not the right eye that is connected with the left hemisphere (and vice versa), rather it is the right part of the *vision field*. This part is captured by the left half of the retinas of *both* eyes. People in the cited experiment (by Mark Jung-Beeman and Edward Bowden) sat in front of a computer screen and arrived at the problem’s solution (with both eyes) either in the left or in the right field of the screen. As a result, the projection arrived in the opposite hemisphere. So the rest of the article is correct.

Pol Craeynest  
Marke, Belgium

## THE READERS WRITE

Last night was the first time I picked up *Scientific American Mind*, and I absolutely love it. I almost purchased *Psychology Today* but did not, because it has too many self-help articles. I am much more interested in recent scientific discoveries, how the mind works, how the senses work, and so on. I like that the publication seems geared to a sophisticated audience. Also, I like the layout and graphics. I plan on subscribing.

Taylor Tudzin  
Los Angeles

I am disappointed to say that I have seen only two—one from this year, one from last year—issues of *Scientific American Mind*. I do not intend to miss another. In the issues I have seen, each story not only interests me but also each and every story calls to me the way dessert does after a fine meal. The stories are not only relevant but highly accessible. I am glad the magazine is now published on a bimonthly schedule; I’m sure it will take me that long to

savor each issue. Congratulations on a fine publication.

**Louis Vitela**  
via e-mail

**I read your issue** from cover to cover and was very impressed by the content. All the articles were very well produced and clearly written. Style-wise, they strike the right balance for me between complexity and intelligibility.

I am a British clinical psychologist who went into mental health service and policy research, and so I read the material from a particular angle. In this light, two pitfalls lurk, and they are linked. Neuroscience approaches to psychological topics (which the discourse in your magazine reflects and reinforces) always are at risk of bioreductionism and naive realism. There were signs of this problem in many of the articles, although you do incorporate cultural arguments some of the time.

My main turnoff on the naive-realist front was your glib acceptance of diagnostic categories such as “depression” and “schizophrenia.” These labels reflect the epistemic error of confusing the map with the territory; they are not facts but constructions (and pretty puny ones at that for scientific purposes).

To boost your credibility with a wider intellectual audience, you could invite social scientists and post-Popperian philosophers of science to write for you or get digests of their material from well-informed journalists. An overreliance on neuroscience will narrow both your audience appeal and your academic credibility.

**David Pilgrim**  
via e-mail

### HO-HUM ISSUE

**I did not like** the October/November 2006 issue. I found little of interest there.

Take the article about people who



**Counting on one's fingers is not for everyone.**

do not count [“Don’t Count on It,” by Annette Lessmoellmann]—boring stuff, that. I count, as do all the people I usually interact with, so this information was of no use and less interest to me.

The special report, headlined as “The Body Speaks,” could have been very interesting. Indeed, I read the articles eagerly, but you gave us little in the way of useful information. What exactly do we look for that tells us *X* or *Y*? Basically, the articles just told us it was possible to read body language and gave examples that proved it. But the package provided almost nothing to help us read such expressions and gestures for ourselves.

One could argue that you provided references and pointers we could have followed up for more. My answer is that I do not have time for that. All I have time for, just barely, is reading the *Scientific American Mind* magazine in my hands. If you cannot give me the information I want right there, then this magazine serves me no purpose.

I do not find articles about people with defects interesting—autism, for example. I prefer items that might help normal people do better with the brain/

mind they have, such as the past articles dealing with mediation, the Dali Lama, and especially lab studies related to them both. I find interesting articles that explain what is going on in *my* head. I only care to read about things that might be of use to me in coping with my rather routine and normal problems—especially anything having to do with how we learn, understand and remember new things, as well as anything having to do with keeping our cognitive abilities intact as we age.

**David March**  
via e-mail

### GRAMMAR POLICE

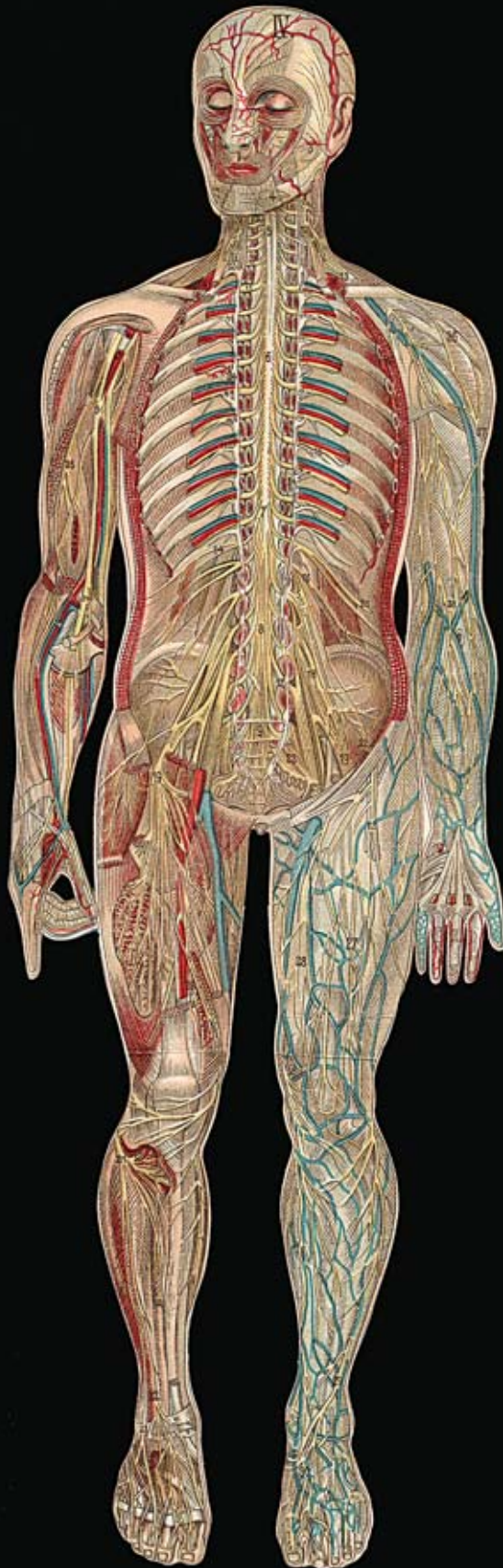
**The article on** complex language and the mind (“Can We Talk?” by Annette Lessmoellmann) is excellent and enlightening. But the sentence she presents as an example of nested modifying clauses is, er . . . well, it’s wrong: “The woman, whose dress, which was not unattractive, and rustled when she walked, sat down next to me.”

Each nested clause needs its own subject and predicate. This sentence could be correctly written in a couple different ways. Each removes a single extraneous word that breaks the syntax of the sentence. Here are two: “The woman, whose dress, which was not unattractive, rustled when she walked, sat down next to me” [removes conjunction “and”]; “The woman, whose dress was not unattractive and rustled when she walked, sat down next to me” [removes pronoun “which”].

**Bill VanAlstyne**  
Rio Rancho, N.M.

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# Head Lines



## My Nervy Valentine

**Around February 14** every year, millions of people think about how their hearts and minds are intertwined with those of their loved ones. Neuroscientists are also talking about newly discovered links between the blood and brain at the molecular level.

Although nerve fibers and blood vessels are closely associated throughout the human body, how this shadowlike pairing becomes established has not been clear. But a report from the recent Society for Neuroscience Meeting in Atlanta announced that a protein familiar to scientists as a powerful stimulant for sprouting blood vessel growth—VEGF (vascular endothelial growth factor)—has the same potent effect on nerves.

Peter Carmeliet of the Flanders Interuniversity Institute for Biotechnology in Belgium reported that VEGF released by nerve cells and glia provides a navigation signal guiding the direction of growing nerve fibers, much the same way blood vessels are stimulated to grow toward the same protein. In addition to engendering new neurons, VEGF protects neurons from lack of oxygen after a stroke.

This factor can also guard mice against a form of amyotrophic lateral sclerosis (ALS), a degenerative neuron disease famous for killing legendary baseball player Lou Gehrig and crippling renowned physicist Stephen Hawking. Restoring normal levels of VEGF in these animals rescues them from death and stimulates new nerve sprouts to form synapses on muscle fibers. The finding could lead to new treatments for many neurodegenerative diseases, including Parkinson's disease, Alzheimer's disease, multiple sclerosis and epilepsy.

Perhaps it should not come as a surprise to find the same growth-promoting protein in blood vessels at work in nerves. Simple animals, such as microscopic nematode worms, need a nervous system to sense food and pursue it, but because they are so small they get all the oxygen they need without a circulatory system. Scientists may have discovered VEGF's circulatory role first, but Carmeliet concludes that VEGF must have originated in nerves and only later in evolution was it adapted to control the growth of blood vessels.

—R. Douglas Fields

STEFANO BIANCHETTI/Corbis



## Sexy Genes for Love and War

**Whether you fight** like a girl or like a boy is hardwired into your nervous system—at least if you are a fruit fly. A research team at Harvard Medical School and the Institute of Molecular Pathology in Vienna discovered that a fruit fly gene named *fruitless*, known to be involved in courtship behavior, also plays an important role in the biology of aggression, directing sex-specific fighting patterns.

Male and female fruit flies fight with distinctly different styles. Female fighting involves head butting and shoving, whereas males prefer boxing and lunges. But when the team swapped the male and female versions



of the gene, the flies switched roles. With a feminine *fruitless* gene in their brains, male flies adopted more ladylike fighting tactics and females carrying the male version of the gene started fighting the way boys do.

“The fact that a single gene is involved in programming several different sex-specific behavior patterns rather than just one is a novel discovery,” says co-author Edward Kravitz of Harvard Medical School. The next step is to identify the neural circuits that are unique to each of the two instincts, he adds.

Even though humans do not have a gene analogous to *fruitless*, the findings could help elucidate the biological basis of human behavior, Kravitz says: “Anything we can learn about how behavior is wired into the nervous system is ultimately going to be relevant.”

—Nicole Branan

## Good Sex Is Not a Rat Race

**For years the story** on rat sex has been this: the male seeks above all else to ejaculate quickly, and once he has done it with one female, he is eager to move on to new partners. The female, meanwhile, seeks to extend the sex encounter through “pacing.” A new study finds that if pacing is slow enough, the male will prefer that familiar partner to someone new. The wait, it seems, makes the female more attractive.

“It’s an awful lot like what we were taught in high school,” says Concordia University psychologist James Pfaus, who co-authored the study with Nafissa Ismail, the graduate student who conceived it.

The experiment made innovative use of standard research devices called pacing chambers, which are cages with dividers having either one or four holes big enough to let a female rat through but too small for the larger male. Thus, the female can join or leave the male, allowing her to significantly lengthen her arousal and, studies have shown, her chance of pregnancy. But the mating rituals last longer in the one-hole chambers, because the male, eager to get at the female, often sticks his big head in the hole, blocking her only passage back to his side and delaying her return.

The researchers let 20 couples mate in one-hole chambers and 20 in four-hole chambers. Then they placed each couple, along with a novel female, in a larger, open area. Among males from four-hole chambers, about half preferred their familiar mates. Among

males who mated more slowly in the one-hole chambers, 80 percent preferred the familiar partner.

Driving this behavioral dynamic is, as always with rat sex, some neurochemical reward. Boston University biologist Mary Erskine notes that “sexual preferences come from chemical rewards, and we can be sure there are some here.” Sexual climax, in fact, unleashes a flood of pleasure-producing hormones and neurotransmitters, such as testosterone and dopamine. Pfaus speculates that the higher level of arousal created by the longer wait generates a stronger release, and a more substantial reward, thereby enforcing the preference.

“Whether it’s simply a stronger dose of the usual chemical rewards or some in addition, we don’t know,” Pfaus says. “But something is making this sort of mating more rewarding to the male or rewarding in a different way.”

—David Dobbs



## TV, TV on the Wall

People have been fascinated with the figure of the narcissistic star at least since Norma Desmond announced that she was ready for her close-up in the 1950 film *Sunset Boulevard*. Norma is not alone—new research shows that celebrities of all types are significantly more vain than other people.

Two University of Southern California researchers conducted the study. One of them, Drew Pinsky, appears on a syndicated radio show called *Loveline*, in which visiting celebrities give relationship advice to callers. Together with his colleague S. Mark Young, Pinsky recruited 200 of his



guests to fill out personality assessments.

These famous subjects scored about 15 percent higher for narcissism than the general population—they were more conceited, had a greater sense of entitlement and superiority, and were more exhibitionistic. Ironically, the “ordinary people” who have become well known through reality TV shows scored the highest in overall narcissism, followed by comedians, actors and finally musicians, who scored only a little higher than nonfamous people.

It could be that celebrity turns people into narcissists, but Young thinks it is the other way around, because narcissism was not affected by how long the celebrities had been famous.

“What they hope is that they will get noticed and stroked,” he says. “What better place to get that than the entertainment industry?”

—Kurt Kleiner

## I, Elephant

“Know thyself” has been the guiding principle of many philosophers. Perhaps the first evolutionary step toward that goal is to realize that a “self” exists, distinct from others. For this, a mirror can be a great help. Humans can recognize their own reflection before the age of two. Chimpanzees and dolphins share the ability. Now elephants are known to be members of the club.

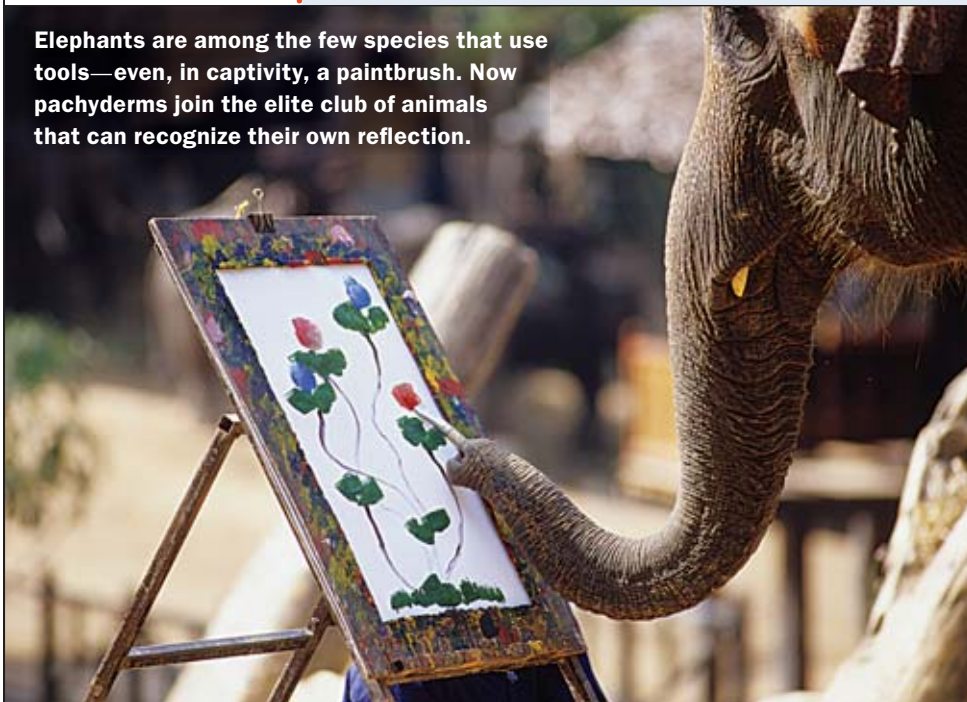
Joshua Plotnik, a graduate student at Emory University, and his colleagues bolted a giant plastic mirror inside the elephant enclosure at the Bronx Zoo and watched three Asian elephants progress from curiously sniffing and feeling around and behind the mirror, to eating in front of it, to inspecting their own mouths, to playing peekaboo. One, named Happy, achieved what scientists consider the gold standard of mirror self-recognition, touching a spot on her body that she could not usually see. The scientists had painted a white spot on her head, which she explored delicately with the tip of her trunk while gazing at her reflection.

Psychologists believe that the capacity for mirror self-recognition co-evolved with the complex social capacity that dolphins, apes and elephants have for empathy. Only these species demonstrate “targeted helping,” in which animals respond to the specific needs of injured or elderly family members. “To have higher social behavior” akin to this, Plotnik explains, “you need to have a higher level of self-awareness.”

A human might find it disturbing to find a big spot painted on his or her forehead. Happy quickly lost interest in it, although she continued to play in front of the mirror. As Plotnik and his co-workers report, elephants bathe by throwing mud over themselves. For pachyderms, “attention to detail is not a priority.”

—Kaspar Mossman

Elephants are among the few species that use tools—even, in captivity, a paintbrush. Now pachyderms join the elite club of animals that can recognize their own reflection.



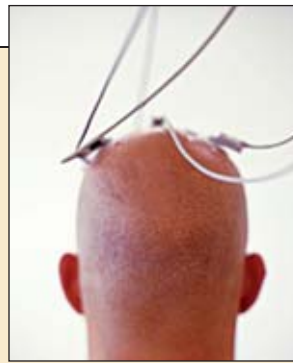
## Hardwiring Memories

**Students are told to** “sleep on it,” because many experiments have shown an early stage of sleep helps consolidate the memory of recently learned facts. Now German neuroscientists have found that stimulating the sleeping brain with external electric fields can further boost memory performance.

Jan Born and his colleagues at the University of Luebeck gave a simple memory test—sets of word pairs—to 13 volunteer medical students and then let them fall asleep. As expected, their ability to remember the words improved after a nap. “Slow-wave sleep,” Born says, “has been suspected to be the phase of sleep when memory consolidation occurs.” During this phase, the brain generates waves of neuronal activity that oscillate from front to back, about once per second. But whereas memories of facts are known to solidify during this slow-wave period, the electrical oscillations themselves were not thought to be important to the process.

Born’s team applied electrodes to their subjects’ heads and allowed them to doze off. When the students were about to enter slow-wave sleep, the scientists induced a slowly oscillating current that was slightly stronger than the brain’s natural one. Five sessions of this stimulation spaced out over half an hour enhanced the slow waves, keeping them strong and synchronizing the activity of neurons. When the subjects awoke and were tested, they could remember almost three more word pairs than control subjects, who were given sham treatment.

Specific brain-wave patterns could also play a role in other sleep stages. Memories of skills, rather than facts, are consolidated during the later stage of rapid eye movement, or REM, sleep. The brain’s electrical activity during this sleep stage is dominated by higher-frequency theta waves. Born’s group now plans to see if artificially reinforcing theta waves during sleep will specifically boost this different kind of memory. —Jonathan Beard



■ **Hallucinations**, delirium and self-injury reported in patients taking the influenza treatment Tamiflu prompted the Food and Drug Administration to call for close monitoring of people taking the drug. Severe flu cases can, on rare occasions, have similar behavioral effects. But the 103 cases—mostly among children—reported in less than one year prompted concerns that this increasingly popular drug was responsible. Individuals and countries have been stockpiling Tamiflu to guard against a possible influenza pandemic.

■ **Drawing a circle** with one hand while outlining a square with the other is an impossible task for most people—unless they stop thinking and are guided only by touch. Psychologists at Pennsylvania State University discovered that volunteers whose hands were gently guided by moving magnetic disks easily trace very different shapes. Using tactile clues appears to bypass the brain’s high-level cognition system, which normally hampers this complex coordination.

■ **Eyes are hard** to trick. British researchers Gustav Kuhn of the University of Durham and Michael Land of the University of Sussex studied people watching a magician perform the “vanishing ball” illusion, during which he pretends to throw a ball. Two thirds of the audience reported “seeing” the ball rise and vanish in midair. But their eyes never moved to where the ball supposedly vanished, suggesting the neuronal system that controls eye motion was not fooled.

## A Cause for SIDS?



**Serotonin is a neurotransmitter** best known for its influence on depression and sexual function. But it also plays less famous roles: serotonin-releasing neurons in the brain stem regulate our body temperature and how we breathe. Henry Krous, a professor of pathology and pediatrics at the University of California, San Diego, and his colleagues have found that a failure of this system may be responsible for sudden infant death syndrome, or SIDS.

SIDS is diagnosed when a sleeping baby dies without obvious cause. An infant who is sleeping face down or who is too warm is more likely to die of SIDS. But this new research suggests some babies may be particularly at risk.

The researchers compared brain stem

tissue from 31 infants who died from SIDS with samples from babies who died of trauma. In the SIDS brains the number of serotonin-responding neurons was much higher; however, protein receptors that detect serotonin and transporters responsible for clearing it from the synapses were both in short supply. These signs point to disruption of the system that monitors babies’ oxygen intake and body temperature and should arouse them if, for example, a pillow makes it difficult for them to breathe. “In a way, it’s comforting for parents,” Krous says; they are not to blame. “The defects are inherent to the baby.”

It would be ideal to screen for infants susceptible to SIDS at birth with, for example, a genetic test. But the researchers could not find a genetic defect in the infants that accounted for these brain stem abnormalities. Unfortunately, the method the team used to find neuronal defects is of no use clinically, as Elliott Sherr, a neurologist at the University of California, San Francisco, points out: “You’re not going to do a brain biopsy on every baby.” But Sherr thinks that animal models of the brain stem defect could ultimately reveal ways to detect the serotonin-neuron defect in a blood sample.

—Kaspar Mossman

## Your Brain on Toxins

**A controversial report** suggests that hundreds of known neurotoxins may be affecting the brains of children around the world and yet are loosely regulated because too high a standard of proof is required before stricter controls are considered.

Philippe Grandjean of the Harvard School of Public Health and co-author Philip J. Landrigan of the Mount Sinai School of Medicine compiled their list of more than 200 chemicals known to be neurotoxic to adults from government databases. For a handful of these chemicals—lead, methylmercury, polychlorinated biphenyls (PCBs), arsenic and toluene—there is also proof that they can harm fetal or child brain development, which has led to their tighter regulation. For example, as a result of these concerns lead was removed from gasoline and paint.

The authors argue that if a chemical is known to harm the brains of adults, then it has a good chance of harming the brain of a fetus or infant,



and it is unwise to allow children to be exposed to these chemicals for years while scientists and lawmakers await final proof. Establishing a causal relation is difficult because each child may be exposed simultaneously to several substances and the effect of each may be small.

But Grandjean says that developing brains are much more susceptible to toxicity than adult brains because affected neurons fail to migrate to their destinations. “This may be one reason why some effects appear to be permanent,” he notes.

Not so, says Jean Harry, who leads the neurotoxicology group at the National Institute for Environmental Health Sciences. “The developing brain, while it’s very sensitive, is elastic,” she explains. Furthermore, she

points out that the placenta and the blood-brain barrier do provide some protection to the fetal brain. Although she does not dispute the importance of identifying and regulating dangerous chemicals, Harry says the authors do not credit regulatory agencies for their “large effort to address these concerns for susceptible populations.” —Karen A. Frenkel

It is unwise to allow children to be exposed to toxic chemicals while awaiting final proof.

## How the Brain Tunes Out

**The difference between** American Idols and the karaoke-challenged may be more than voice deep. Researchers have found that tone-deaf people have an unusual distribution of neurons in the front of their brains.

Tone-deaf individuals cannot recognize familiar songs without lyrics and do not realize when their own singing is out of tune. About 4 percent of people carry this trait. Previously researchers have hunted for the roots of this musical inability in the auditory centers of the brain. But they did not find any differences in these regions between tone-deaf and normal listeners. So Krista Hyde of the Montreal Neurological Institute at McGill University and her colleagues scanned entire brains to search for anatomical anomalies. They found that the amusical subjects had less white matter—neuron axons that are wrapped in an insulating sheath of myelin—in the right inferior frontal gyrus. The worse they performed on musical pitch tests, the less white matter they had.

Such individuals also had more gray matter—unmyelinated neurons—in the same region. Other imaging studies have recently suggested this brain area plays a role in musical-pitch processing and memory. This neuroanatomical difference could be the result of neurons not migrating properly during development. Similar malformations are associated with neural developmental disorders, such as dyslexia. “Tone deafness might be analogous to something in language,” Hyde says. “These disorders exist in language, so why not in music? One can argue that music is another language.” Uncovering these brain differences could lead to treatment for tone deafness, he adds. That could be music to many ears. —Alison Snyder



DAVID SEED Getty Images (top); CONEYL JAY Getty Images (bottom)

For nonhuman primates, camouflaged eye movements clearly serve a purpose.



## Keep Your Eyes on the Eyes

**Unlike other primates**, the whites of human eyes contrast sharply with our colored irises and dark pupils. One theory suggests that our eyes evolved this way specifically to make it easier to figure out the direction of another person's gaze. If this theory is correct, you would expect humans to pay more attention to eye orientation than other primates do.

To find out, researchers at the Max Planck Institute for Evolutionary Anthropology in Leipzig compared the behavior of adult chimps, gorillas, bonobos and human children.

A person stood in front of the ape or child and looked up and to the sides, either moving only his head, only his eyes, or both his head

and eyes. Apes and children both looked where they thought the experimenter was looking. But the apes paid the most attention to the motion of the head, whereas the children paid the most attention to the motion of the eyes.

But why would humans evolve easy-to-read eyes? For other primates, camouflaged eye movements clearly serve a purpose. "For non-human primates, you don't want anybody to see what you're looking at. You want to eat it, or mate it, or chase it," states Brian Hare, a biological anthropologist who co-authored the paper. Instead Hare says we evolved to make it easy for everyone to see where we were looking. The advantages of cooperation through mutual gaze must have been so great that they outweighed the advantage of a poker face. — Kurt Kleiner

## The Remembrance of Fruits Past

**Color lives in the memories**, as well as the eyes, of the beholder, suggests a German study of how people perceive the color, or colorlessness, of fruit. Karl Gegenfurtner and his colleagues at Justus-Liebig University in Giessen put their subjects in front of a computer screen with digital images of fruits—a banana, for example—in brown, purple or any arbitrary color. The subjects were then instructed to use the computer's software to manipulate the fruits' color. When asked to make a gray—or colorless—banana, all 14 subjects made images that were slightly blue.

"In order for the banana to look a neutral gray, they had to make it bluish," Gegenfurtner says, "because a gray banana still looked yellow to them." The actual deviation



from neutral gray varied between 4 and 13 percent, but all of them added blue, yellow's complimentary color (the one opposite it on a color wheel) to the images to make them look gray.

But why should our brains distort our perception of color rather than representing it truly? "Our brain uses the knowledge that stop signs and strawberries are red, for example, to recognize them, even when they are barely illuminated by dim moonlight," Gegenfurtner explains. In effect, the brain adds red to make them recognizable, adjusting their real color toward a "memory color." The researchers also point out that even in daylight this color adjustment has a purpose. Sunshine contains more blue in the morning, and yellow fruits would shift their appearance toward gray in those conditions. But because of the influence of color memory, bananas appear to have a more consistent hue throughout the day. —Jonathan Beard

# The Case of the Loud Eyeballs

In which a mystery is solved through a chance encounter  
BY R. DOUGLAS FIELDS

SO THESE TWO GUYS walk into a bar. No—this is a true story! One is a neuroscientist (yours truly), and the other is a writer for *Scientific American Mind*. (We'll call him Bill.) We are at the recent meeting of the Society for Neuroscience in Atlanta. A gentle bear of a man comes over, licking suds from his lips and praising the local brew with an authoritative German accent. As he raises his glass to the light to inspect the beer's clarity, I think to myself, "This is my chance." So I tell him about a bizarre thing my eyes do.

"My eyeballs make this horrid grating noise when they move," I say. (This sound effect may be amusing in cartoons, but it's a real pain in the neck when I am trying to fall asleep.) Now usually when I make a public confession about my noisy eyeballs, my audience gets a queer look on their faces, as if I am sprouting fur under a full moon. But Josef Rauschecker of Georgetown University, one of the world's authorities on the auditory cortex as well as on local brews, listens intently.

"The weird thing," I add, "is that it only happens in that twilight between falling asleep or waking up." (You know, that dreamy, peaceful Neverland that you wish would last just a bit longer before the alarm clock rudely smacks you out of it.) "It's a loud, irritating noise, but as soon as I awaken my eyeballs go silent." In fact, I have tried to experiment with the phenomenon, darting my eyes left and right and up and down. But as soon as my mind becomes lucid enough to investigate, the noise vanishes.

"Me, too!" Bill shouts above the bar-room din. I look at him as if *he* has just



sprouted fur. But, Bill tells us, his eyeballs do not shriek when he is waking up. Instead it happened years ago, when he stopped taking his medication for depression: "It freaked me out!"

Rauschecker considers us. "I know what your problem is," he says. I listen in astonishment. What are the chances of meeting someone who shares my oddball noise in front of the only person in the world who could understand it?

"Serotonin," Rauschecker pronounces. Serotonin is a neurotransmitter that stimulates neurons in the nucle-

us accumbens to activate it. He explains that his recent brain scans of people suffering from tinnitus, a constant ringing in the ears, show that a particular part of their brain—the nucleus accumbens—is smaller than normal [*see box on opposite page*]. This nugget of nerve cells is a throttle point regulating the flow of sensory information to the cerebral cortex via another major relay center, the thalamus. Now it all makes sense to me as a neuroscientist, but let me explain it for you.

Like a valve on a water faucet, the

What are the odds of meeting someone who shares my **oddball noise** in front of the one person who could understand?

EMELY/zefa/Corbis

Had we shared coffee instead of beer, would Bill and I have felt forthcoming enough to reveal our **peculiar secrets**?

nucleus accumbens prevents an overload of sensory input from reaching our conscious mind. Controlling this information flow is important for sleep, attention and anxiety and for suppressing unwanted noise. That guy yapping on his cell phone, oblivious to the conversations around him, is an example of the nucleus accumbens in action. All he hears is the person talking on the phone; he is deaf to sounds in his other ear, because his nucleus accumbens shuts off the input to his auditory cortex. People suffering from ringing in their ears are unable to shut off the irritating noise because of their feeble nucleus accumbens valve.

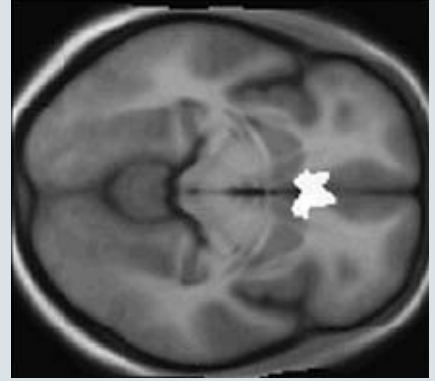
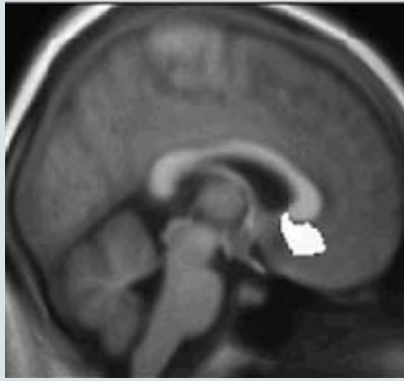
### Sleep and Serotonin

The same sensory shutoff function is essential for sleep. Serotonin levels fluctuate in the sleep-wake cycle, and serotonin is a well-known sleep aid. The sleep centers of the brain (raphe nuclei) connect to the nucleus accumbens. The emotional center of the brain (amygdala) also connects to it. Inputs to the nucleus accumbens from both the emotional and sleep centers of our brain explain why our sensations sharpen with arousal and stress but are blunted by sleepiness.

People with depression or bipolar disorder also are experiencing a kind of sensory blockage. In depression, no amount of sensory stimulation seems to move the patient. The trickle of input from the world is too feeble to excite the cerebral cortex normally. On the other hand, when the nucleus accumbens valve is stuck wide open, a veritable fire hose of input blasts the cortex in response to any sensory input, leading to mania.

In my case, nerve fibers must have sprouted to repair my hearing loss after I had suffered damage to my inner ear, but some of the sprouts “cross-wired” to circuits that normally connect my eyes to my vestibular system

## The Brain’s Shutoff Switch



Nucleus accumbens (*white areas*) is smaller in people with tinnitus, making their brains less able to screen out nonsense noise caused by damaged hair cells in their ears. Flaws in neural “wiring” or function in the nucleus accumbens can also lead to other sensory problems—like my own loud eyeballs. —R.D.F.

(responsible for the sense of balance). Thanks to this vital connection the world does not blur like an amateur video when you turn your head; cells in your inner ear sense that your head is moving, and they send signals to your eyeball muscles to adjust their position, always keeping the same point in space focused on the same spot on your retina at the back of your eye. In my case, “crosstalk” developed between these nerve circuits after my hearing injury, so now when my eyes move, signals reach my auditory cortex and I perceive the input as noise.

Normally, dysfunctional noise gets filtered out. For example, the thunderous sounds in our head caused by talking or chewing would disrupt hearing if they were not shut off before reaching the auditory cortex. In cases of people who have tinnitus, doctors may someday prescribe a small dose of selective serotonin reuptake inhibitor (SSRI) drugs—the same ones used for treating depression—a bit of serotonin, or the diet supplement tryptophan, which the body uses to make serotonin.

“We must write you two up as a case history for the medical literature,” Rauschecker tells us. I am just delighted to know at last that my eyeballs’ sound effects are simply my nucleus accumbens still snoozing. As soon as I wake up, it wakes up, too, and gets back to work filtering out important incoming messages from the junk.

I left the party stunned by the serendipity. What if we three had not happened by chance to meet in a bar? Had we shared coffee instead of beer, would Bill and I have felt forthcoming enough to reveal our peculiar secrets? Something as important as science should not be left to chance—but so often that is the way it is. **M**

R. DOUGLAS FIELDS is adjunct professor in the Neuroscience and Cognitive Science Program at the University of Maryland.

### (Further Reading)

◆ **Structural Brain Changes in Tinnitus.** M. Mühlau et al. in *Cerebral Cortex*, Vol. 16, No. 9, pages 1283-1288; September 2006.

FROM “STRUCTURAL BRAIN CHANGES IN TINNITUS,” BY M. MÜHLAU, J. P. RAUSCHCKER, E. OESTREICHER, C. CASER, M. RÖTTINGER, A. M. WOHLISCHLÄGER, F. SIMON, T. ETGEN, B. CONRAD AND D. SANDER, IN *CEREBRAL CORTEX*, VOL. 16, NO. 9, PAGES 1283-1288; SEPTEMBER 2006. BY PERMISSION OF OXFORD UNIVERSITY PRESS

# A Moving Experience

How the eyes can see movement where it does not exist

BY VILAYANUR S. RAMACHANDRAN AND DIANE ROGERS-RAMACHANDRAN

**THE GREAT RENAISSANCE** scholar and artist Leonardo da Vinci left a legacy of paintings that combined beauty and aesthetic delight with unparalleled realism. He took great pride in his work but also recognized that canvas could never convey a sense of motion or of stereoscopic depth (which requires that two eyes simultaneously view slightly different pictures). He recognized clear limits to the realism he could portray.

Five hundred years later the limits of depicting depth in art remain true (except of course for “Magic Eye”-style prints, which, through multiple similar elements, basically interleave two views that the brain sorts out for each eye). But Leonardo could not have anticipated the Op Art movement of the 1960s, whose chief focus was to create the illusion of movement using static images. The art form grew

Viewing the image with your peripheral vision makes the motion appear more pronounced. Staring fixedly at the image may diminish the sense of movement, but changing your eye position briefly by looking to one side refreshes the effect. In this image, you see movement in the direction that follows the colored segments from black to blue to white to yellow to black. Yet the colors are merely added for aesthetic appeal and have no relevance to the effect. An achromatic version (*b*, on page 16) works equally well so long as it preserves the luminance profile of the colored version (in other words, as long as the relative reflected luminance of the different patches remains the same).

These delightful displays never fail to titillate adults and youngsters alike. But why does this illusion arise? We do not know for sure. What we do

slightly to the right, you will see the patch of dots moving (jumping) to the right, because the change activates multiple motion-detecting neurons in your brain in parallel. This phenomenon is termed apparent motion, or phi. It is the basis for “motion” pictures in which no “real” motion exists, only successive still shots.

But if in the second frame you displace the dots to the right and also reverse the contrast of all the dots so that they are now white on gray (instead of black on gray), you will see motion in the opposite direction—an illusion discovered by psychologist Stuart Anstis, now at the University of California, San Diego. This effect is known as “reversed phi,” but we shall henceforth call it the Anstis-Reichardt effect, after the two vision scientists who first explored it. (The second person was Werner Reichardt, then at the

## How is a motion-detecting neuron in the brain “wired up” to detect the direction of motion?

wildly popular in the culture at large—the mother of one of us (Rogers-Ramachandran) even wallpapered an entire bathroom in a dizzying swirl of such black-and-white patterns.

The movement never really attained the status of sophisticated “high art” in the art world. Most vision scientists, on the other hand, found the images to be intriguing. How can stationary images give rise to motion?

Psychologist Akiyoshi Kitaoka of Ritsumeikan University in Tokyo has developed a series of images called Rotating Snakes, which are particularly effective at producing illusory motion. As you gaze at *a*, you soon notice circles spinning in opposite directions.

know is that the odd arrangements of luminance-based edges must somehow “artificially” activate motion-detecting neurons in the visual pathways. That is, the particular patterns of luminance and contrast fool the visual system into seeing motion where none exists. (Do not be alarmed if you don’t see the movement, because some people with otherwise normal vision do not.)

To explore motion perception, scientists often employ test patterns of very short movies (two frames in length). Imagine in frame one a dense array of randomly placed black dots on a gray background. If, in frame two, you displace the entire array

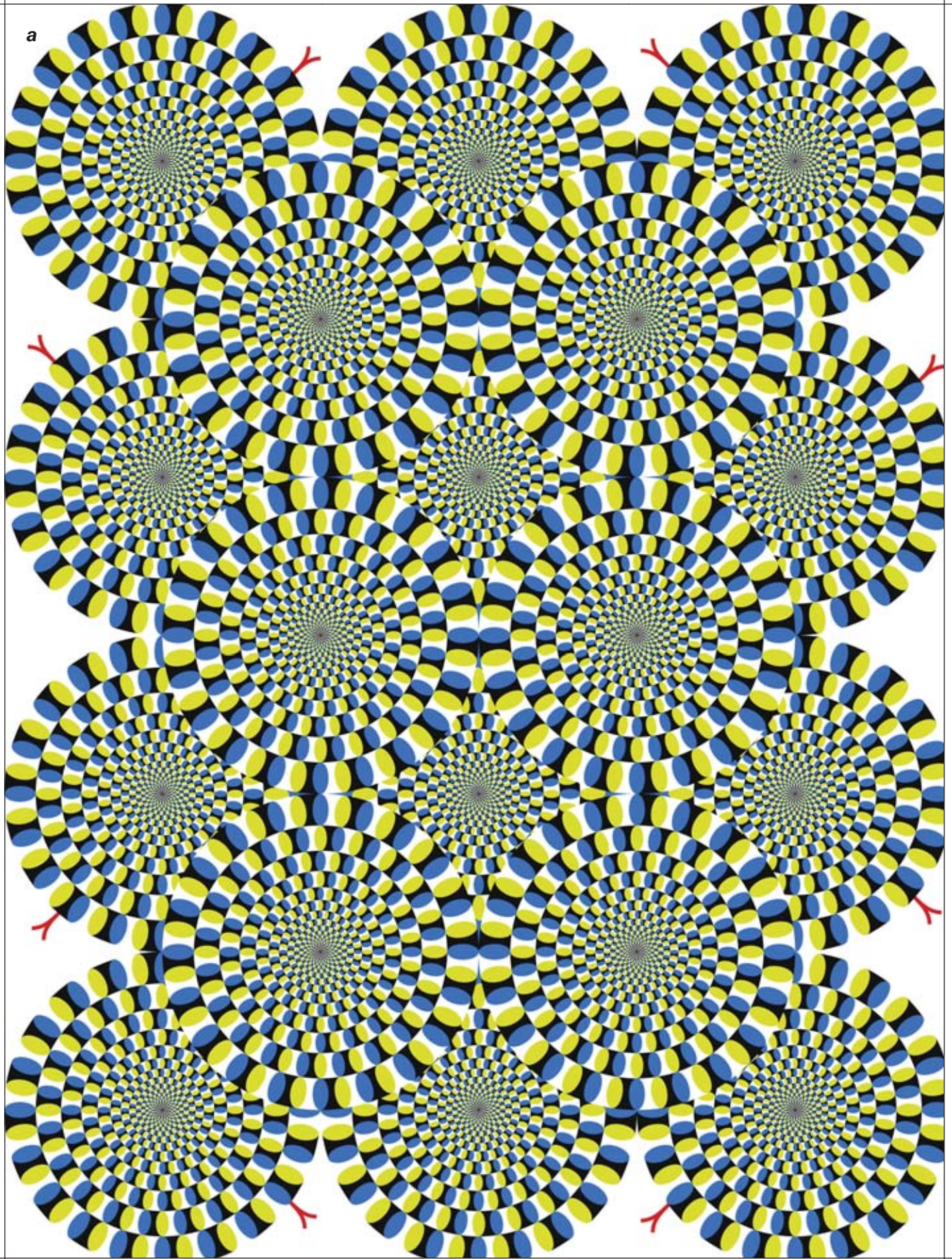
Max Planck Institute for Biological Cybernetics in Tuebingen.) We now know that this paradoxical reverse motion occurs because of certain peculiarities in the manner in which motion-detecting neurons, called Reichardt detectors, operate in our visual centers.

### Wired for Motion

How is a motion-detecting neuron in the brain “wired up” to detect the direction of motion? Each such neuron or detector receives signals from its receptive field: a patch of retina (the light-sensing layer of tissue at the back of the eyes). When activated, a cluster of receptors in, say, the left side of the

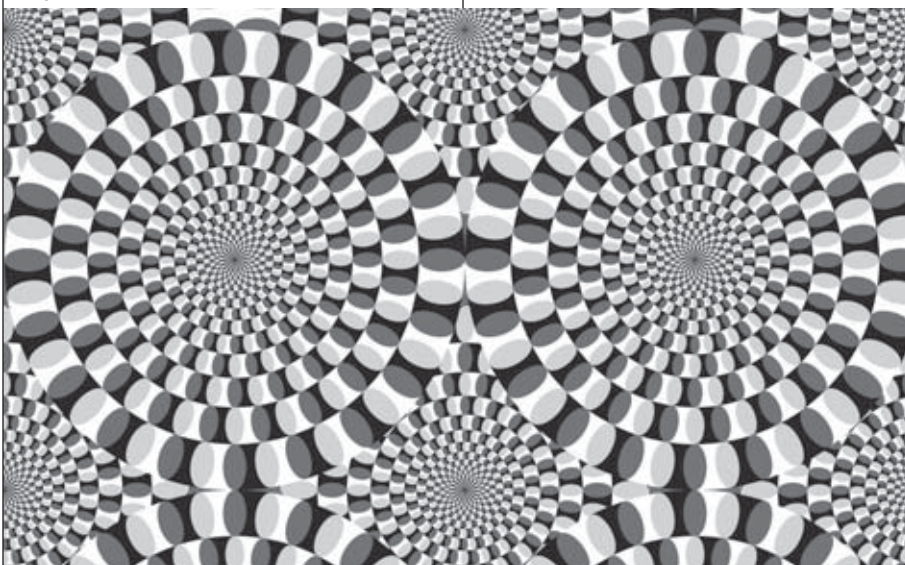


a



AKIYOSHI KITAOKA 2003

b



receptive field sends a signal to the motion detector, but the signal is too weak to activate the cell by itself. The adjacent cluster of retinal receptors on the right side of the receptive field also sends a signal to the same cell if stimulated—but, again, the signal is too weak on its own.

Now imagine that a “delay loop” is inserted between the first patch and the motion-detecting neuron but not between the second (right) patch and the same neuron. If the target moves rightward in the receptive field, the activity from the second patch of retina will arrive at the motion-detecting neuron at the same time as the delayed signal from the left patch. The two signals together will stimulate the neuron adequately for it to fire. Such an arrangement, akin to an AND gate, requires the circuit to include a delay loop and ensures direction as well as velocity specificity.

But this is only part of the story. In addition, we have to assume that for some reason we have yet to understand, stationary displays such as *a* and *b* produce differential activation within the motion receptive field, thereby resulting in spurious activation of motion neurons. The peculiar stepwise arrangement of edges—the variation in luminance and contrast—in each subregion of the image, combined with the fact that even when you fixate steadily your eyes are making

ever so tiny movements, may be critical for artificially activating motion detectors. The net result is that your brain is fooled into seeing motion in a static display.

### Enhancing Motion

Finally, it is also known that patterns with a certain amount of regularity and repetitiveness will excite a large number of motion detectors in parallel, very much enhancing your subjective impression of motion. A small section of this display is insufficient to generate noticeable motion, although the massively parallel signals from the highly repetitive patterns together produce strong illusory motion. Readers may want to conduct a few casual experiments themselves: Is the illusion any stronger with two eyes than with one? How many snakes are necessary to see them writhing?

The manner in which stationary pictures work their magic to create tantalizing impressions of motion is not fully understood. We do know,

however, that these stationary displays activate motion detectors in the brain. This idea has also been tested physiologically, by recording from individual neurons in two areas of the monkey brain: the primary visual cortex (V1), which receives signals from the retina (after being relayed through the thalamus), and the middle temporal area (MT) on the side of the brain, which is specialized for seeing motion. (Damage to the MT causes motion blindness, in which moving objects look like a succession of static objects—as if lit by a strobe light.)

The question is, Would static images like the rotating snakes “fool” motion-detecting neurons? The initial answer seems to be yes, as has been shown in a series of physiological experiments published in 2005 by Bevil R. Conway of Harvard Medical School and his colleagues.

Thus, by monitoring the activity of motion-detecting neurons in animals and simultaneously exploring human motion perception using cunningly contrived displays such as *a* and *b*, scientists are starting to understand the mechanisms in your brain that are specialized for seeing motion. From an evolutionary standpoint, this capability has been a valuable survival asset as an early warning system to attract your attention—whether to detect prey, predator or mate (all of which usually move, unlike stones and trees). Once again, illusion can be the path to understanding reality. **M**

VILAYANUR S. RAMACHANDRAN and DIANE ROGERS-RAMACHANDRAN are at the Center for Brain and Cognition at the University of California, San Diego. They serve on *Scientific American Mind*'s board of advisers.

### (Further Reading)

- ◆ **Phi Movement as a Subtraction Process.** S. M. Anstis in *Vision Research*, Vol. 10, No. 12, pages 1411–1430; December 1970.
- ◆ **Perception of Illusory Movement.** A. Fraser and K. J. Wilcox in *Nature*, Vol. 281, pages 565–566; October 18, 1979.
- ◆ **Neural Basis for a Powerful Static Motion Illusion.** Bevil R. Conway, Akiyoshi Kitaoka, Arash Yazdanbakhsh, Christopher C. Pack and Margaret S. Livingstone in *Journal of Neuroscience*, Vol. 25, No. 23, pages 5651–5656; June 8, 2005.
- ◆ Stuart Anstis's Web site for “reversed phi” effect:  
<http://psy.ucsd.edu/~sanstis/SARevMotion.html>

# (calendar)



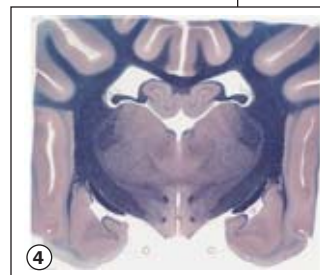
1



2



3



4

## MUSEUMS/EXHIBITIONS

### 1 San Francisco Psychedelic

An amorphous artistic and musical movement emerged in the late 1960s—pivoting around a suite of chemicals dedicated to inducing cognitive distortion and other bizarre psychological effects—and created an enduring slice of social history. This exhibit shows the work of the photographers who captured on film the idealistic pioneers of the counterculture movement. A companion exhibit at the museum, *San Francisco Psychedelic Posters*, shows contemporaneous concert posters.

Minneapolis Institute of Arts  
February 10–June 10  
888-MIA-ARTS (888-642-2787)  
[www.artsmia.org/](http://www.artsmia.org/)

### 2 Journeys: Mapping the Earth and Mind in Chinese Art

The didactic pictorial examination of travel in Chinese art is interwoven with more expressive “journeys of the mind,” where as long ago as the 11th century, artists sought an aesthetic refuge from troubled times by “roaming through the mountains or escaping to wilderness retreats or utopian paradises.” The work resonates with us today, as the viewer can still vicariously reach a similar destination in those evocative landscapes.

Metropolitan Museum of Art, New York City  
February 10–August 26  
212-535-7710  
[www.metmuseum.org/](http://www.metmuseum.org/)

## CONFERENCES

### 2007 Annual Meeting of the American Association for Geriatric Psychiatry

Topics such as “cognitive impairment and late life depression,” while perhaps depressing for all of us, might encourage work that ameliorates the lives of aging people everywhere. The association’s Web site also has advice for nonprofessionals, with techniques designed to “promote healthy aging strategies.”

New Orleans  
March 1–4

301-654-7850; fax: 301-654-4137  
[main@aagponline.org](mailto:main@aagponline.org)  
[www.aagponline.org/](http://www.aagponline.org/)

### Society for Research in Child Development Biennial Meeting

The SRCD promotes “research in the field of human development” and with the help of their biennial meetings (the last one had more than 5,000 attendees) encourages the practical application of findings from researchers who contribute from all over the world.

Boston  
March 29–April 1  
[swansonb@srcd.org](mailto:swansonb@srcd.org)  
[www.srcd.org/biennial.html](http://www.srcd.org/biennial.html)

### MOVIES/DVD Because I Said So

After her youngest daughter endures serial dating failures, a strong-willed mother (Diane Keaton) steps in to help find the “perfect man.” Said daughter (Mandy Moore), like all children who are resolute (or obstinate, depending on the circumstances), would rather do it herself instead of trusting to Mom’s ad on an Internet dating site (not a bad instinct, given the iffy results of these sites, described by Robert Epstein in “The Truth about Online Dating,” on page 28). The test of wills in this comedy is as much about love as it is about letting go.

Universal Pictures  
Wide release February 2  
[www.becauseisaidssomovie.com/](http://www.becauseisaidssomovie.com/)

### 3 Flags of Our Fathers Letters from Iwo Jima

These two films, both directed by Clint Eastwood, lay bare the core beliefs of two societies by looking at one of the most ferocious battles between them. *Flags of Our Fathers* is the American view of the fight for Iwo Jima, where the determined Marines endured 26,000 wounded and dead on the battlefield—and a few more casualties among the survivors who were feted as “heroes” back home.

In *Letters from Iwo Jima*, Lt. Gen. Tadamichi Kuribayashi (Ken Watanabe) knows that he and the Japanese troops under his command, to fulfill their duty, will die defending the island against overwhelming odds.

Flags: Paramount Pictures (U.S.)  
DVD release scheduled for March 2007  
[www.flagsoffourfathers.com](http://www.flagsoffourfathers.com)  
Letters: Warner Brothers (worldwide)  
Wide release in the U.S. February 2007  
<http://iwojimathefilm.warnerbros.com>

## WEB SITES

4 <http://brainmaps.org/>  
Since this Web site first appeared in May 2005, Edward Jones of the University of California, Davis, and his colleagues have expanded the information to encompass some 40 terabytes of data that include more than 12 million megapixels of brain images in extraordinary, manipulatable detail. There are complete brain atlases of several species, such as *Tyto alba* (barn owl) and *Macaca mulatta* (the rhesus monkey, not the maligned college student from Virginia); the atlas of our brain is still a work in progress.

The data can be navigated with sophisticated applications, available from the site. Brainmaps.org is not for the casually interested reader, but it is fascinating to see how the power of the Internet can be harnessed.

### <http://crimepsychblog.com/>

It is not the lurid, breathless sensationalism of the dime novel but “a place to collate information of interest in a forensic psychological context.” The blog, based in England, covers the psychological aspects of all kinds of criminal behavior, as well as its investigation and punishment and the treatment of its victims. Geared at least in part to professionals, the blog provides notices of forthcoming papers and jobs in the U.S. and the U.K.

Compiled by Dan Schlenoff.  
Send items to [editors@sciammind.com](mailto:editors@sciammind.com)

JAVIS JOPLIN, 1967 BY BOB SEIDEMANN, COURTESY OF THE MINNEAPOLIS INSTITUTE OF ARTS; (1); RETURNING HOME, BY SHITAO (ZHU RUOJI, 1642–1707), FROM THE P. Y. AND KINMAY W. TANG FAMILY COLLECTION, THE METROPOLITAN MUSEUM OF ART; (2); LETTERS FROM IWO JIMA, FROM DREAMWORKS PICTURES AND WARNER BROS. PICTURES; PHOTOGRAPH BY MERIE W. WALLACE; SMPSP (3); COURTESY OF BRAINMAPS.ORG (4)





# SEX and the SECRET NERVE

**Could a little-known cranial nerve be the route by which human pheromones turn us on?**

By R. Douglas Fields

**W**e stood around the body planning our autopsy strategy. A scalpel, we realized, was not going to be the appropriate implement for this corpse, so we made our decision. It took all three of us to muscle the slippery black bulk of the pilot whale into the screaming blur of the band-saw blade.

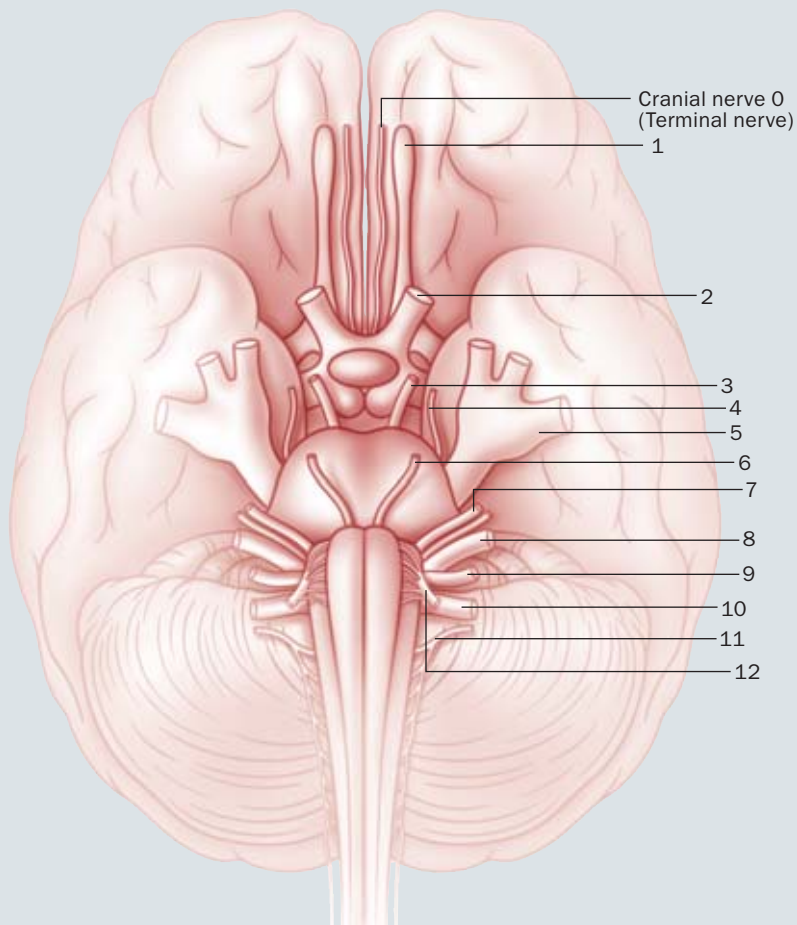
The whale had died of natural causes, after a distinguished military tenure conducting deep-sea operations for the U.S. Navy, which sends marine mammals to places where humans cannot safely go. In death, it was going to perform one more service—provide us with information about its magnificent brain. The navy had invited Scripps Institution of Oceanography researchers to come to its base in San Diego in the mid-1980s, and I had joined them. Dressed like fishmongers in black rubber smocks and boots, anatomist Leo S. Demski, visiting from the University of Kentucky, veterinarian Sam H. Ridgway of the Naval Oceans Systems Center and I sought to unravel a scientific mystery. It was imperative that we learn whether the whale had a certain cranial nerve—for reasons that will soon become apparent.

Every picture of the human brain you have seen is wrong. Something is missing, and the omission is not trivial. The dirty little secret is a tiny, relatively unstudied nerve sprouting from the base of the brain whose function is only now becoming clear: subliminal sexual attraction. Many scientists believe that pheromones, those silent chemical messages exchanged by members of the opposite sex in search of mates, relay subconscious signals to the brain through this obscure nerve. Others

CORBIS (faces); GETTY IMAGES (Illuminated brain);  
PHOTOCOMPOSITION BY SCIENTIFIC AMERICAN MIND

# Mysterious Nerve

Cranial nerves emerge from the floor of the brain in pairs; each pair is numbered from the front of the brain (closest to the forehead) to the back (near the spinal cord). Cranial nerve zero (also called the terminal nerve) is not in typical textbooks. Anatomists historically missed the thin nerve, perhaps because it is often inadvertently pulled off along with the tough membranes that wrap the brain.



are skeptical. How can a little-studied nerve be involved in activities with such important implications for human behavior—especially when anatomists have scrutinized every minute detail of the human body for centuries? Could there be more to choosing a mate than we consciously realize? Researchers like us have been working to find out.

Tracking this mysterious cranial nerve brought me to the pilot whale, as a model for understanding our fellow mammals. For reasons that I will explain, it was particularly important to find out if this nerve exists in whales.

Most nerves enter the brain through the spinal cord, but some—the cranial nerves—enter the brain directly. The existence of some of the cranial nerves, if not their precise function, has been known since the time of Greek philosopher and physician Galen (who lived circa A.D. 129 to 210). Today we understand that they provide the vital senses of smell, sight, hearing, taste and touch; they are also involved in the movement of

the eyes, jaw, tongue and face. Cranial nerves emerge from the floor of the brain in pairs, like a multilegged centipede. As every medical student knows, each nerve pair is numbered in sequence from the front of the brain (closest to the forehead) to the back (near the spinal cord).

Cranial nerve one is the olfactory nerve. All the scents of the world enter our brain through this nerve. Next, immediately behind the olfactory nerve, is cranial nerve two, the optic nerve. The optic nerve connects the eyes to the brain. The pairs continue in sequence to the 12th cranial nerve, which extends from the tongue and enters the brain near the spinal cord. Each pair was carefully identified, numbered and studied in detail. Then, in the late 1800s, neuroanatomists had their tidy understanding of cranial nerves attacked, so to speak, by a shark.

In 1878 German scientist Gustav Fritsch noticed a slender cranial nerve entering the brain of a shark just ahead of all the known nerves. No one else had noticed it before. Even today count-

TAMITOLPA; SOURCE: "NERVUS TERMINALIS (CRANIAL NERVE ZERO) IN THE ADULT HUMAN," BY G. N. FULLER AND P. C. BURGER, IN *CLINICAL NEUROPATHOLOGY*, VOL. 9, NO. 6; NOVEMBER 1990

less students in anatomy classes dissect dogfish sharks, but few detect the nerve because it is still not in the textbooks.

The discovery put anatomists in a predicament. Because it was located in front of the olfactory nerve, the new nerve should have been named cranial nerve one. But renumbering all the cranial nerves at this point was impossible, because their identities were deeply entrenched in the medical vocabulary. The solution was to christen this new find “nerve zero,” the “terminal nerve.” Most people forgot about it altogether.

done in the evolutionary exchange of nostrils for blowhole. But if, as we suspected, nerve zero did something else, it might still be present in whales.

Before I relate the results of our autopsy, you must have a look at some of the evidence that raised our suspicions that nerve zero connects the sense of smell to sex.

### Smell and Pheromones

Smell is the most ancient of all the senses—even the lowly bacterium must discern the difference between nutritious and noxious substances

( Indications are that people do exchange such secret pheromone messages. )

er. It just did not fit within the 12-nerve curriculum. And anyway, all five senses were accounted for by the other cranial nerves. How important could this little nerve be?

It would have been easier to overlook this inconvenient discovery if nerve zero were present only in sharks. But over the next century anatomists found the wispy nerve springing from the brain just in front of the olfactory nerve in almost all vertebrates (animals with backbones). To their chagrin, they found the nerve in humans, too, in 1913. Usually it is ripped away during dissection when the tough membranes that wrap the brain are peeled off, but if one knows where to look and is especially careful, the little nerve is always there. What is its purpose?

One clue comes from how it is connected in the brain. Like the olfactory nerve, nerve zero sends its endings to the nose. Perhaps, some researchers argue, this nerve is simply a frayed strand of the olfactory nerve and not a separate cranial nerve at all. The dead pilot whale, my colleagues and I realized, was a perfect opportunity to examine that notion by looking directly to an example from nature.

Whales and dolphins are unique in having a blowhole on the top of their head. Whales evolved from aquatic mammals that breathed through nostrils in the front of the face. Over the course of millions of years of evolution the nostrils gradually migrated to the top of their head. In the process, whales and dolphins gave up the sense of smell, and they lost their olfactory nerve. We realized that if nerve zero were also involved in the sense of smell—as just a twig branching off of the olfactory nerve—it, too, would have been aban-

by sniffing (detecting chemicals in) its environs. Humans, who have a weak sense of smell compared with most mammals, nonetheless have 347 different types of sensory neurons in the olfactory epithelium, where cells for smell reside in the nose. Each one detects a different type of odor, and all the varied aromas and stench we know result from mixtures of responses of these 347 types of receptor cells. In comparison, every color we see results from signal combinations of only three types of sensory neurons in the retina (red-, green- or blue-sensitive cones), vision’s sensing layer at the back of the eyes.

Animals rely heavily on the sense of smell and other nonverbal cues for communication. From frenzied June beetles to tomcats pursuing a queen in heat, pheromones are important for selecting mates and stimulating reproduction throughout the animal kingdom. A stallion curls its upper lip and inhales deeply to snuffle pheromones from a mare in heat, a behavior called flehmen. Many animals also rely on the sense of smell to determine sex, social rank, territories, reproductive status and even identity of specific individuals, such as their own mates or offspring.

In humans, mate selection and sexual reproduction are far more complex, but there are indications that people do exchange such secret pheromone messages. We will examine the evidence—some of it reported only in the past few months—but for now it is sufficient to appreciate that pheromones differ in two important ways from the chemicals that excite our sense of smell. For a smell to waft a distance from its source, the odor-producing molecules must be very small and volatile (able to float great distances in the

air). Not so for pheromones, which can be large molecules passed between the noses of individuals during intimate contact, such as kissing.

Second, not all pheromones have an odor. If pheromones were to excite nerve endings that convey their signals directly to brain regions controlling sexual reproduction, bypassing the cerebral cortex where consciousness arises, they could act like an unseen olfactory cupid—putting a romantic twinkle in the eye of a certain member of the opposite sex—and we would never know it.

sal cavity known as the vomeronasal organ. This organ, in turn, is connected to a tiny “accessory” olfactory bulb, next to the main olfactory bulb involved in the sense of smell. From there, nerves connect to areas of the brain involved in sexual arousal (such as the amygdala) rather than to the olfactory cortex. In rodents, for example, stimulating the vomeronasal organ with pheromones can release a flood of sex hormones into the blood.

Acting through the vomeronasal organ, pheromones influence the frequency of estrus and

## Pheromones could act like an unseen olfactory cupid—putting a romantic twinkle in the eye of a mate.

As it turns out, nerve zero’s connections in the brain leave open that very possibility. To explain how requires a more detailed look at the circuitry for the sense of smell and for a special structure in the nose of many animals that detects pheromones, called the vomeronasal organ.

The olfactory nerve connects sense cells in our nose to the olfactory bulb inside our skull. This neural bulb is a massive relay point containing a nest of synapses. Raw incoming sensory information from the 347 kinds of odor receptors is first sorted here, then processed to analyze and discriminate among the universe of odors. The signals next pass to the olfactory cortex for finer discrimination and conscious perception of the odor.

For many animals that rely on pheromones for sexual communication, the key place for sensing these chemicals is a specialized area inside the na-

stimulate sexual behavior and ovulation in animals. The wrong pheromones can even terminate a pregnancy. In 1959 Hilda M. Bruce of the National Institute for Medical Research in London reported that an embryo will not implant in the uterus of a recently mated female mouse if she is exposed to the smell of urine from an unfamiliar male. Instead the embryo will be aborted, and the female will return to estrus. In contrast, the smell of urine from her mate does not prevent implantation and pregnancy.

In research published in 2006, Nobel laureate Linda Buck and her colleague Stephen Liberles of the Fred Hutchinson Cancer Research Center in Seattle identified 15 members of a new family of receptor proteins. These receptors, found in the mouse nose, exist on the surface of sense cells that detect pheromones, lending credence to the

Pilot whale brains lost the olfactory nerve during evolution but retained nerve zero—an important clue to its function.



DAVID A. NORTHCOTT Corbis



idea of a separate pathway for pheromones in mammals. These cells are different from the receptors that detect odors. Each of the newly discovered TAARs (trace amine-associated receptors) responds selectively to specific nitrogen-containing molecules in mouse urine. The concentration of one of these chemicals increases in mouse—and human—urine under the stresses associated with mating behavior, such as those involving dominance and submission. Two of the TAARs are excited by compounds found exclusively in the urine of male mice, but only after puberty, also suggesting a sex link. Incidentally, behavioral researchers had previously identified one of these compounds and found that it accelerated the onset of puberty in female mice.

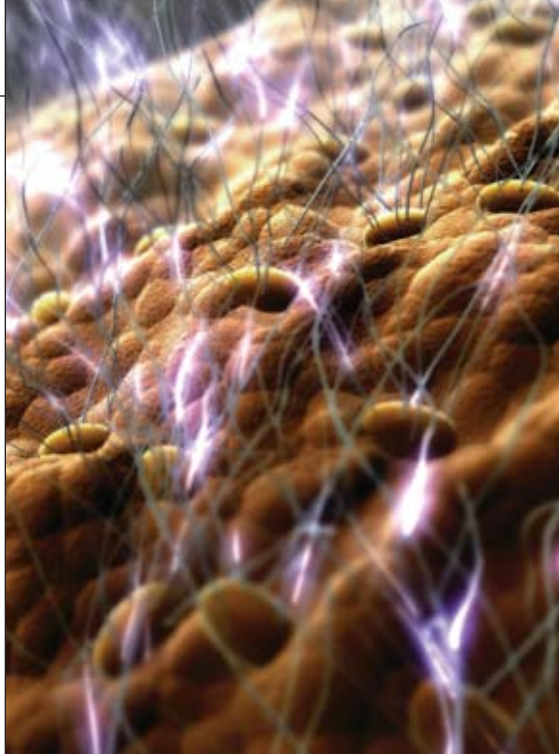
We now have an understanding of pheromones in mice that extends from molecules to sexual behavior, but what about pheromones in humans? Intriguingly, Buck found that humans have the genes to make at least six of the same pheromone receptors present in mice.

### Nerve Zero's Role

Although some scientists claim to have detected an operational vomeronasal organ in humans as well, most believe that it appears to be vestigial. As is the case with gill slits, we possess vomeronasal organs only during our fetal lives, after which they atrophy. So if pheromones are sending sexual signals to human brains, they are not relying on the vomeronasal organ to relay them. Instead nerve zero might be stepping into the breach.

Consider the following anatomical features of nerve zero. Like its olfactory cousin, nerve zero has its endings in the nasal cavity, but remember that it sends its nerve fibers to the hot-button sex regions of the brain: the medial and lateral septal nuclei and preoptic areas. These regions of the brain are concerned with the “nuts and bolts” of reproduction. They control release of sex hormones and other irresistible urges such as thirst and hunger. The septal nucleus can act on and be influenced by the amygdala, hippocampus and hypothalamus. Damage to the septal nuclei causes behavioral changes in sexual behavior, feeding, drinking and rage reactions. Thus, in connecting the nose to the reproductive centers of the brain, nerve zero completely bypasses the olfactory bulb.

Cutting the olfactory nerve or removing the vomeronasal organ will disrupt normal mating behavior in rodents, suggesting that the olfactory nerve transmits pheromone messages from the vomeronasal organ. But in the past few years, researchers have come to understand that nerve



Vomeronasal organ in a mouse transmits sexual signals to the brain. In humans the organ is vestigial. Could nerve zero provide a similar function?

zero *also* sends fibers to the vomeronasal organ—and that nerve zero’s fibers run extremely close to the fibers of the olfactory nerve. As a result, in experiments in which the olfactory nerve was deliberately severed, investigators may have inadvertently cut through nerve zero as well.

In 1987 neuroscientist Celeste Wirsig, then at Baylor College, carefully severed the nerve zero of male hamsters, leaving the olfactory nerve unscathed (as shown by the fact that hamsters with a severed nerve zero could find a hidden cookie just as fast as control animals could). The hamsters with a severed nerve zero failed to mate.

Similarly, in 1980, neuroscientists observed that electrically stimulating the olfactory nerve could trigger sexual responses in fish and other animals. But could this sexual behavior actually result from a stimulated nerve zero, which runs close to the olfactory nerve for most of its length? Neuroanatomists R. Glenn Northcutt of the University of Michigan at Ann Arbor (now at the University of California, San Diego) and Demski of Kentucky (now at the New College of Florida) suspected as much. They also knew that on their way to the brain, some fibers in nerve zero took an unexpected side trip and sent branches to the retinas of the eyes. This may seem odd until you realize that for most plants and animals, reproduction is seasonal—and day length is the most

### (The Author)

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## Chemical Messages

**W**hat is it about sexual attraction that can instantly draw two people together? Could pheromones be a factor for human couples, as they are for other animals? Research on molecules that protect us from infections offers intriguing clues.

In many animals, the nose can determine sex and reproductive status by sensing trace hormones and other compounds in urine and sweat. A different class of molecules provides information about the individual identity of a mate. Such macromolecules, called major histocompatibility complex (MHC) proteins, sit on the surface of cells to allow the immune system to distinguish the body's own cells from foreign ones.

Here is how it works. MHC molecules are huge proteins equipped with bird-beak-like appendages that snatch small protein fragments inside cells and poke them through the cell membrane for guard patrols called T cells to inspect. If the protein fragments are foreign, the immune system attacks.

Some studies suggest that people can discern whether someone has different MHC genes. Biologist Claus Wedekind of the University of Edinburgh reported in the mid-1990s that in one study women preferred the odor of T-shirts worn two nights by men who had different MHC genes from their own; men had the same ability to distinguish MHC genes by smell. In a 1997 study geneticist Carole Ober of the University of Chicago and her colleagues reported that people avoid mating with individuals carrying the type of MHC genes most similar to those of their own mothers.

It makes good evolutionary sense to mate with someone who has a different set of MHC genes, because doing so increases the arsenal of immune system genes in your children and thus allows them to better resist infection. It is also biologically important to diminish sexual arousal toward one's own family members, who are most likely to share your variety of MHC genes. The Wedekind and Ober



**Stallion snuffles pheromones from a mare in heat.**

studies suggest that an individual's odor is affected by the particular variety of MHC genes he or she has. This effect may come about because differences in an individual's immune system alter the body's bacterial flora and, in turn, the resulting odors created by the breakdown of sweat and apocrine gland secretions by these bacteria. But would nature leave such a vital process as mate selection under the control of microbes, which can change with infections and other environmental influences?

As it turns out, it is not the MHC protein itself that is the pheromone. Recent research indicates that it is the small protein fragment clutched in the jaws of the MHC molecule. In 2004 neurobiologist Trese Leinders-Zufall of the University of Maryland School of Medicine and her colleagues found that when synthetic protein fragments that are more readily picked up by classes of MHC proteins in unfamiliar mice were added to the urine of the female mouse's mate, pregnancy was blocked just as if she had been exposed to urine from an unfamiliar male mouse. —R.D.F.

accurate way to gauge time of year. Many scientists suspect that a nerve involved in mating and reproduction might also connect to the retina to keep a constant check on the calendar. Regardless of function, this place was where nerve zero and the olfactory nerve parted company, so Northcutt and Demski were able to apply a mild electric shock to goldfish nerve zero fibers in this site without stimulating the olfactory nerve at the same time. When they did, the male goldfish responded instantly by releasing sperm.

So in addition to the anatomical evidence that nerve zero connected the nose to parts of the

brain controlling sexual reproduction, strong physiological evidence now existed that—in fish at least—nerve zero might be a sensory system for responding to sex pheromones and regulating reproductive behavior. Another lead pointing to a sexual role for nerve zero would come from my own research, again on a creature from the sea.

In 1985, while studying nerve zero of a stingray using the electron microscope, I saw something peculiar: many of its axons (nerve fibers) were stuffed with what looked like minuscule black spheres. They turned out to be peptide hormones packed tightly together like pellets in a

KIT HOUGHTON Corbis

# Nerve impulses travel out from the brain through nerve zero, but their purpose is unknown.

shotgun shell. And at the tips of some of these nerves I observed the release of these hormones and their uptake by tiny blood vessels—suggesting that nerve zero may in fact be a neurosecretory organ, meaning that it regulates reproduction by releasing hormones in much the same way as the pituitary gland does. This new clue that the terminal nerve released sex hormones, together with the knowledge that it connected the nose to parts of the brain controlling sexual reproduction, triangulated on one conclusion: pheromones.

Yet skeptical scientists have credited arousal exclusively to the olfactory nerve, still arguing that nerve zero is not a separate cranial nerve at all but simply a frayed strand of the olfactory nerve. So when Demski and I heard that a pilot whale had just died at the San Diego Naval Base, we jumped at the chance to examine it. This animal could show us whether nerve zero was truly autonomous and might even help to illuminate its function.

## Whale of a Find

Back in the lab at Scripps, Demski reached into a plastic bucket with gloved hands and withdrew the pilot whale's brain that we had removed from the immense carcass. It was about the size of a soccer ball and resembled a human brain, except that its cerebral cortex had tighter and more numerous convolutions—almost kinky in comparison to the wavy folds of a human cortex.

After turning over the whale brain for a look at its underside, we were struck by the strangeness of seeing a mammalian brain devoid of its olfactory nerves. (Remember that whales lost their sense of smell in exchange for blowholes.) Demski carefully peeled away the membranes from the area in which we expected to find a pair of nerve zeros, assuming they had not been lost along with the olfactory nerves. With the surprise of unwrapping a present, we found them: two slender white nerves headed toward the whale's blowhole.

Our postmortem on the pilot whale had proved that nerve zero was a distinct neural entity, not just a fragment of the olfactory nerve. And for whales and dolphins, which had sacrificed their sense of smell and the olfactory nerves that made it possible, whatever nerve zero did was too precious to survival for evolution to abandon.

Despite the intriguing findings, nerve zero's role in the sexual behavior of humans remains

unclear. Recent research in mice has revealed the presence of certain sensory neurons that are *not* associated with the vomeronasal organ but that respond to pheromone stimulation. So even without a functioning vomeronasal organ, our noses may nonetheless contain sensory neurons capable of responding to pheromones.

How much of this labor is split between the olfactory nerve and nerve zero is not yet worked out. Obviously, nerve zero is doing something different with the information it is receiving from the nose, because it does not connect to the olfactory bulb where smells are analyzed. Moreover, it connects to parts of the brain controlling reproduction, and it releases a powerful sex hormone (GnRH) into the blood. Nerve zero develops very early in embryos, and studies show that all the neurons in the forebrain that produce GnRH use the fetal nerve zero as a pathway to migrate along to find their proper place in the brain. When this embryonic pathway is disrupted, Kallmann's syndrome is the result. This disorder not only impairs people's sense of smell, it leaves them unable to mature sexually beyond puberty. Undoubtedly, nerve zero has other functions in addition to reproduction—most cranial nerves transmit both sensory and motor (related to body movement) traffic. Electrical impulses have been detected traveling out from the brain through nerve zero, but what the outgoing messages do is unknown.

Ultimately, more research will be needed to fully detail nerve zero's role in the brain. But at least now you understand that nature provides a hidden channel of communication between the sexes to sustain the cycle of life, and scientists know where to begin to solve this intriguing puzzle. This secret nerve, missing from textbooks but shared by creatures from sharks to people, remains, like the intimate function it serves, still wrapped in secrecy. **M**

## (Further Reading)

- ◆ **The Terminal Nerve (Nervus Terminalis) Structure, Function and Evolution.** Special issue of *Annals of the New York Academy of Sciences*, Vol. 519; January 1987.
- ◆ **Pheromones and Animal Behavior.** Tristram D. Wyatt. Cambridge University Press, 2003.
- ◆ **Terminal Nerve.** Leo S. Demski in *Encyclopedia of Neuroscience*. Third edition. Edited by George Adelman and Barry H. Smith. Elsevier, 2004.
- ◆ Pheromone facts are available at [www.sciammind.com](http://www.sciammind.com)

# The Truth about

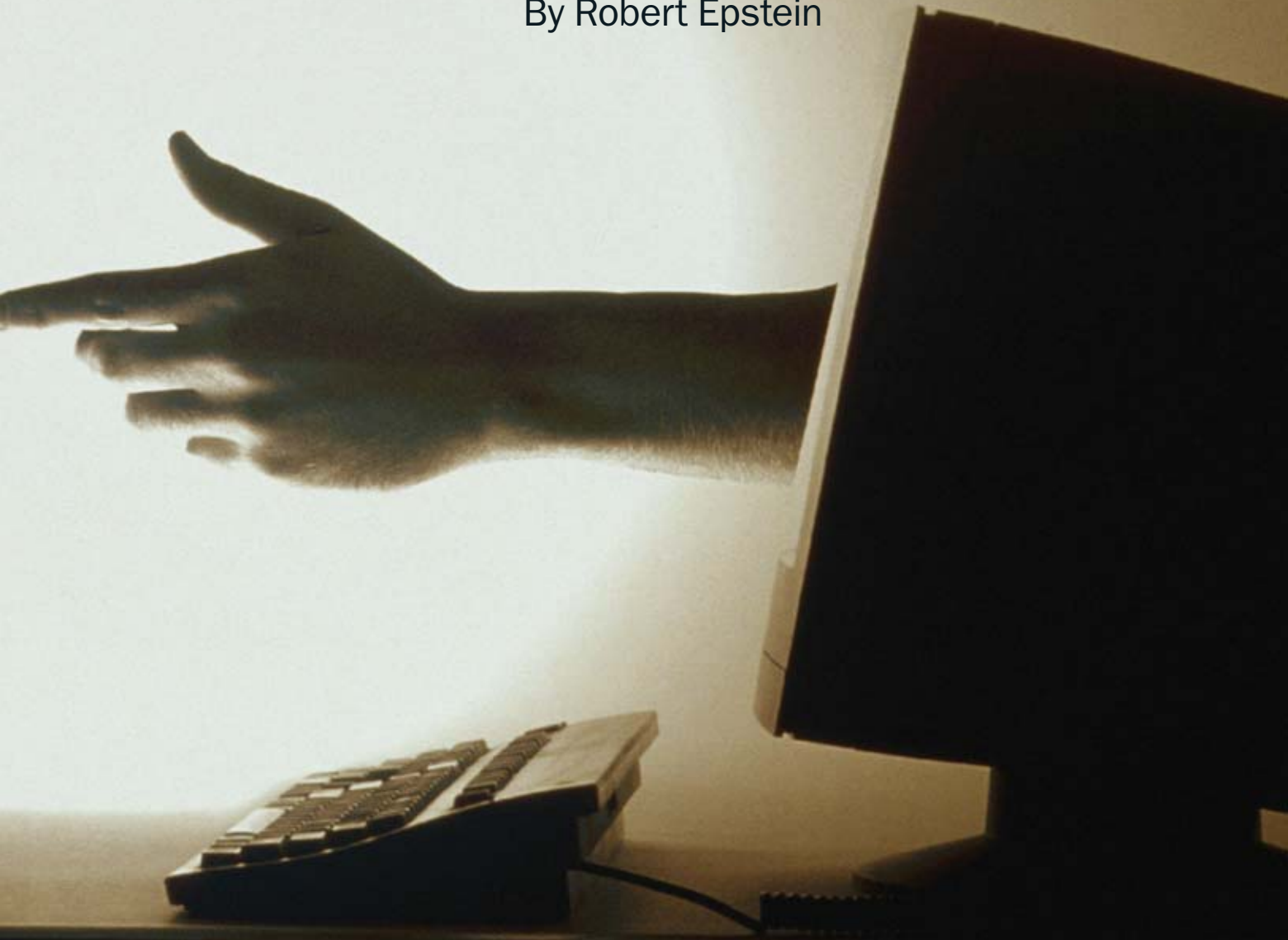
The hype is huge, and the findings are disturbing—



# Online Dating

but the future of online dating looks good

By Robert Epstein



**A**bout two years ago I arranged to meet for coffee with a woman I had corresponded with online. I arrived early and sat at a table in a conspicuous spot. After a few minutes, a woman came to my table, sat down and said with big smile, “Hi, I’m Chris!”

But Chris was not the woman in the online photos. This wasn’t a question of an age discrepancy or a new hairdo. She was a completely different woman.

Chris was in marketing, you see, and to her it was simply a good strategy to post photographs that would draw in as many “customers” as possible. I never said a word about the photos. I just enjoyed our conversation and the refreshments. A few weeks later I noticed that Chris had replaced the photos with those of yet *another* woman.

In the U.S. alone, tens of millions of people

are trying to find dates or spouses online every day. How accurate are the ads they find? And just how successful is online dating compared with conventional dating? These and other questions have recently stimulated a small explosion of studies by social scientists. The research is quickly revealing many surprising things about the new world of online dating, and some of the findings could be of great value to the millions who now look to the Internet to find love.

### Deception at Light Speed

Experiences such as the one I had with Chris are multiplying by the thousands: some people online lie quite drastically about their age, marital or parental status, appearance, income or profession. There are even Web sites, such as [www.DontDateHimGirl.com](http://www.DontDateHimGirl.com), where people go to gripe, and a few lawsuits have been filed against online services by disgruntled suitors. Just how bad is deception in online dating?

To put this issue in context, bear in mind that deception has always played at least a small role

On the Internet, nobody knows you’re a dog: in one study, about 20 percent of online daters admitted to deception.



RON CHAPPLE Getty Images (preceding pages); FREITAG ze/fa/Corbis (this page)

in courting. One could even argue that deception is a *necessary* part of wooing a potential partner (“Yes, I *love* sports!”) and even of forming successful long-term relationships (“No, that dress doesn’t make you look fat at all!”).

But cyberspace introduces a host of new possibilities. Survey research conducted by media researcher Jeana Frost of Boston University and the Massachusetts Institute of Technology sug-

gests that about 20 percent of online daters admit to deception. If you ask them how many *other* people are lying, however—an interviewing tactic that probably gets closer to the truth—that number jumps to 90 percent.

Because self-reported data can be unreliable, especially those from people asked to confess bad things about themselves, several researchers have sought objective ways to quantify online deception. For example, psychologist Jeffrey Hancock of Cornell University and communications professor Nicole Ellison of Michigan State University bring people into a lab, where they measure height and weight and then check the numbers against those in their online profiles. The preliminary data suggest that, on average, online profiles shave off about five pounds and add perhaps an inch in height. According to Ellison, although deception is “fairly common, the lies are of a very small magnitude.” On the other hand, she says that the shorter and heavier people are, the bigger the lies.

In another attempt to collect objective data on deception, economists Guenter Hitsch and Ali Hortaçsu of the University of Chicago and psychologist Dan Ariely of M.I.T. compared the heights and weights of online daters with the same statistics obtained from national census data. Like Hancock and Ellison, they found that online height is exaggerated by only an inch or so for both men and women but that women appear to understate their weight more and more as they get older: by five pounds when they are in their 20s, 17 pounds in their 30s and 19 pounds in their 40s.

For men, the major areas of deception are educational level, income, height, age and marital status; at least 13 percent of online male suitors are thought to be married. For women, the

major areas of deception are weight, physical appearance and age. All of the relevant research shows the importance of physical appearance for both sexes, and online daters interpret the absence of photos negatively. According to one recent survey, men’s profiles without photos draw one fourth the response of those with photos, and women’s profiles without photos draw only one sixth the response of those with photos.

## Online daters often regret telling the truth, feeling that too much honesty creates a bad impression.

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If you are a Garrison Keillor fan, you have probably heard about the fictional Lake Wobegon on National Public Radio, where “all the women are strong, all the men are good-looking, and all the children are above average.” In the online dating community, similar rules apply: in one study, only 1 percent of online daters listed their appearance as “less than average.”

### Rationale for Falsehoods

Why so much inaccuracy? One theory, formulated in the late 1980s and early 1990s by Sara Kiesler and her colleagues at Carnegie Mellon University, suggests that by its very nature “computer-mediated communication” is disinhibiting, causing people to say just about anything they feel like saying. Because people typically use screen names rather than real ones, their ramblings are anonymous and hence not subject to social norms. There are also no physical cues or consequences—no visible communication gestures, raised eyebrows, grimaces, and so on—to keep people’s behavior in check. As a result, online daters tend to construct what Ellison and her colleagues Jennifer Gibbs of Rutgers University and Rebecca Heino of Georgetown University call an “ideal self” rather than a real one. A study published recently by Ellison and her colleagues even suggests that online daters often regret it when they do tell the truth, feeling that too much honesty, especially about negative attributes, creates a bad impression.

There are also straightforward, practical reasons for lying. One recent study showed that men claiming incomes exceeding \$250,000 got 151 percent more replies than men claiming incomes less than \$50,000, for example. Many women are quite open about listing much younger ages, often stating in the text of their profiles that they

# Ten Commandments for Online Lovers

**1 BE VAGUE.** The more information you provide, the poorer the impression you will create, shows research by psychologist Michael I. Norton of Harvard University, media researcher Jeana Frost of Boston University and the Massachusetts Institute of Technology, and psychologist Dan Ariely of M.I.T. People mistake vagueness for attractiveness, filling in the missing details in ways that suit their own desires.

**2 BE ENTHUSIASTIC.** When psychologist Larry D. Rosen of California State University, Dominguez Hills, asked women to choose between men who sent neutral e-mails (“I like my job”) versus enthusiastic e-mails (“I love my job!”), three quarters of the women said they preferred the latter.

**3 HAVE COFFEE.** If you think there is some potential for a relationship, move swiftly to arrange a brief, safe, face-to-face encounter. The volumes of information you get in such a meeting in just a few minutes quickly override any other impressions you might have formed in multiple e-mails or even phone calls.

**4 DON'T PAY.** Avoid high month-to-month fees—or any fees, for that matter—by looking for free membership deals or joining one of the gratis social networking sites. Beware the “pay to respond” sites that allow you to sign up without paying but then charge you before you can respond to any e-mails.

**5 FORGET THE TESTS.** Until scientifically validated, predictive tests are available online, don't waste your time or money on sites offering to find your soul mate through testing. At this point, no one knows how to do such matching, no matter what the hype. And even if such tests do appear someday, remember the problem of “false negatives”: the test might mistakenly steer you away from your perfect mate.

**6 DON'T GET HOOKED.** The online dating environment is so huge that one can easily spend hours every day sending out e-mails, replying to those received and searching profiles. Unfortunately, almost none of that activity leads to a relationship or even to a phone call. Try to limit your online dating activities to no more than a few minutes a day—and don't forget about the real-world alternatives: join a club or take classes.

**7 BE HONEST.** Although a certain amount of deception is normal in any dating experience, dishonesty ultimately backfires. It is important to present yourself in the best possible light, but do not get carried away.

**8 MAKE CONTACT.** Research by communications expert Andrew Fiore of the University of California, Berkeley, shows that the best predictor of how many e-mails people receive is how many they send. If you really want to find someone, don't just sit there. Initiate contact and also respond to the interesting messages you receive.

**9 INVOLVE YOUR FRIENDS.** Look for online services that allow friends and family members to come online with you—preferably free of charge—and let them help you find your mate. To be healthy, dating should never be done in social isolation.

**10 BE PATIENT.** With advertisements making extravagant promises and millions of people available to you at the click of a mouse, your expectations are bound to be high. But online dating is a slow, frustrating experience for most people. Expect to spend at least three to six months, and possibly much longer, finding someone with whom you are compatible. —R.E.

*To take Robert Epstein's new test of relationship skills, go to <http://myloveskills.com>; to visit his home page, go to <http://drrobertepstein.com>*

have listed a younger age to make sure they turn up in searches. (Because men often use age cut-offs in their searches, women who list ages above that cutoff will never be seen.)

My research assistant Rachel Greenberg and I have examined the age issue by plotting a histogram of the ages of 1,000 men and 1,000 women selected at random from the national database of Match.com, arguably now the largest of the online matchmaking services. We speculated that from age 29 on—the point at which people in our culture tend to become sensitive about growing

older—we might see some distinctive patterns in the distribution of ages [see box on page 34]. For men, a small spike appeared in the distribution at 32 and a large one at 36. The number of men calling themselves 36 was dramatically higher than the average frequency of men between the ages of 37 and 41.

For women, we found three clear age spikes at 29, 35 and 44. The difference between the number of women claiming to be 29 and the average frequency of women claiming to be between ages 30 and 34 was nearly eight times larger than



we would expect by chance. Apparently women at certain ages are reluctant to reveal those ages—and certain numerical ages are especially appealing, presumably because our culture attaches less stigma to those ages.

### Tests That Fail

I have been a researcher for about 30 years and a test designer for nearly half those years. When I see extravagant ads for online tests that promise to find people a soul mate, I find myself asking, “How on earth could such a test exist?”

The truth is, it doesn’t.

For a psychometric evaluation to be taken seriously by scientists, the test itself needs to clear two hurdles. It needs to be shown to be reliable—which means, roughly, that you can count on it to produce stable results. And it needs to be shown to be a valid measure of what it is supposed to be measuring. With a test that matches people up, such validity would be established by showing that the resulting romantic pairings are actually successful.

Criteria for establishing test reliability are quite rigorous. Once relevant data are collected, the results are typically submitted to the scientific community for scrutiny. A peer-reviewed report (one vetted by other knowledgeable researchers in the field) is ultimately published in an academic journal.

Several online services are now built entirely around claims that they have powerful, effective, “scientific” matchmaking tests—most notably eHarmony.com, promoted by clinical psychologist Neil Warren; PerfectMatch.com, promoted by sociologist Pepper Schwartz of the University of Washington; and Chemistry.com (a recent spin-off of Match.com), promoted by anthropologist Helen Fisher of Rutgers. But not one of the tests they offer has ever been subjected to the type of outside scientific verification that I have described.

Why would a major company such as eHarmony, which claims to have 12 million members, *not* subject its “scientific, 29-dimension” test to a scientific validation process? In 2004 eHarmony personnel did present a paper at a national convention claiming that married couples who met through eHarmony were happier than couples who met by other means. Typically such a paper would then be submitted for possible publication in a peer-reviewed journal. But this paper has still not been published, possibly because of its obvious flaws—the most problematic being that the eHarmony couples in the study were



newlyweds (married an average of six months), whereas the couples in the control group (who had met by other means) were way past the honeymoon period (married an average of 2.1 years). (eHarmony personnel, including its founder, Neil Warren, did not respond to requests to be interviewed for this article.)

In 2005, using eHarmony’s own published statistics, a team of credible authorities—among them Philip Zimbardo, a former president of the

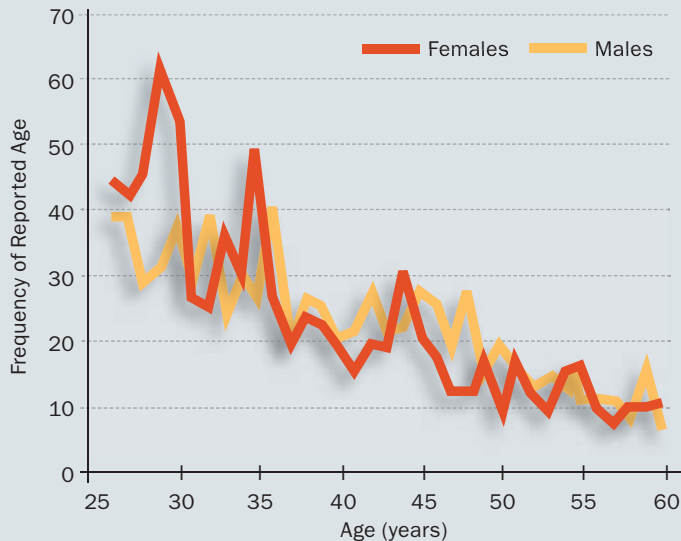
It is easy to get hooked by the online world, but face-to-face meetings are the real test.

### (The Author)

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## Lying about Age

**S**uspicious spikes in ages in a random sample of 1,000 female and 1,000 male profiles from Match.com suggest that online daters lie about their ages. The curve for males has a small spike at age 32 and a larger one at age 36. The number of men claiming to be 36 is 84 percent higher than the average frequency of men claiming to be between ages 37 and 41—a difference more than seven times larger than could be expected by chance. For women, three clear spikes occur at ages 29, 35 and 44. The difference between the number of women claiming to be 29 and the average frequency of women claiming to be between the ages of 30 and 34 is nearly eight times larger than could be expected by chance. The difference between the number of women claiming to be 35 and the average frequency of women claiming to be between ages 36 and 43 is more than five times larger than could be expected by chance. —R.E.



American Psychological Association—concluded in an online white paper: “When eHarmony recommends someone as a compatible match, there is a 1 in 500 chance that you’ll marry this person. . . . Given that eHarmony delivers about 1.5 matches a month, if you went on a date with all of them, it would take 346 dates and 19 years to reach [a] 50% chance of getting married.” The team also made the sweeping observation that “there is no evidence that . . . scientific psychology is able to pair individuals who will enjoy happy, lasting marriages.”

Think about how difficult this task is. Most online matching is done, for example, by pairing up people who are “similar” in various respects.

But you do not need to look farther than your own family and friends to know that similarity is not always a good predictor of success in a relationship. Sometimes opposites really do attract. How could an online test possibly determine whether you should be paired with someone similar or with someone different, or with some magic mix?

And even if validated predictive tests eventually appeared online, how could such tests possibly predict how two people will feel when they finally meet—when that all-important “chemistry” comes into play? Oddly enough, eHarmony does not even ask people about their body type, even though research shows unequivocally that physical appearance is important to both men and women.

But the biggest problem with online testing is the “false negative problem.” A test that determines in advance whom you might meet and whom you will *never* meet necessarily fails to allow certain people to meet who would adore each other. The good news, though, is that according to psychologist Larry D. Rosen of California State University, Dominguez Hills, “In our studies only 30 percent of the people say they use [online tests] at all, and most of those people find them ridiculous.”

### High Hopes and Poor Odds

Advertising materials from the largest online dating services—Match, eHarmony, True.com and Yahoo! Personals—suggest that more than 50 million Americans are now using such services (assuming relatively little overlap in membership) and that satisfaction levels are high. But recent independent studies suggest that only 16 million Americans were using online dating services by late 2005 and that satisfaction levels were low. Based on a phone survey with more than 2,000 people, Jupiter Research reports that “barely one quarter of users reported being very satisfied or satisfied with online personals sites.” Another extensive survey conducted by Pew Internet & American Life Projects suggests that 66 percent of Internet users think that online dating is a “dangerous activity.”

According to Trish McDermott, a longtime spokesperson for Match and now an executive at Engage.com, the confusion over membership figures results from the fact that while a large company such as Match might advertise that it has 15 million members, less than a million are actually paying customers. The others have full profiles online—an important marketing draw—

but cannot respond to e-mails. This is one of several reasons, according to McDermott, why many paying members get frustrated by a lack of response to their e-mails; the vast majority of people in the profiles simply *cannot* respond.

One of my greatest concerns about online dating has to do with what I call “the click problem.” We already have a commitment problem in America, one of several reasons why roughly half of first marriages and about two thirds of second

realistic, social corrective for the deception that plagues cyberspace. The community approach is also evident in the sprawling new social networking sites such as Facebook, Friendster and MySpace; MySpace alone has more than 100 million members. Although the social networking sites appeal mainly to young users and are not strictly dating sites, they bring the community back into whatever dating is generated there. On mega dating sites such as eHarmony and Match,

## Virtual dating takes care of the safety concerns that prevent many people from meeting in person.

marriages here end in divorce. Online dating probably is making things worse.

No matter what Hollywood tells us, long-term relationships take patience, skill and effort. In cyberspace, unfortunately, the bar is so long and the action so quick that few people are willing to put up with even the slightest imperfection in a potential mate. If someone is the wrong height or wears the wrong shoes or makes the wrong kind of joke, he or she is often dismissed instantly. After all, it is a simple matter to go back and click, with tens of thousands of potential mates ready to fill the void.

### Virtual Dating and More

These many problems notwithstanding, the future of online dating and matchmaking looks bright. Interest is growing rapidly, and intense competition will force rapid changes in the kinds of services that are offered. In 2001 online dating was a \$40-million business; by 2008 that figure is expected to break \$600 million, with more than 800 businesses, both large and small, vying for every dollar.

The online dating model is already developing rapidly. Phase one—the Long Bar—is exemplified by companies such as Match, True and Yahoo! Personals. Phase two—the Long Test—is the bread and butter of companies like eHarmony and PerfectMatch. But phase three is already well under way.

Engage, for example, allows members to bring friends and family with them online, all of whom can prowling the profiles, checking people out and matching them up. Members can also rate the politeness of their dates, as well as the accuracy of the profiles. This is the new “community” approach to online matching—a natu-

dating is done in complete social isolation, a matter of great concern to Ellison and other researchers in this area.

And the next step in online dating—“virtual dating”—is already being developed. Using special software developed by the M.I.T. Media Lab, researchers Frost, Ariely and Harvard University’s Michael I. Norton recently reported that people who had had a chance to interact with each other (by computer only) on a virtual tour of a museum subsequently had more successful face-to-face meetings than people who had viewed only profiles. One major bonus: virtual dating takes care of the safety concerns that prevent many people from meeting in person.

Take this just a small step forward: people meeting and chatting in a romantic virtual cafe on the Champs-Élysées in Paris—seeing and hearing each other online as they interact in this beautiful setting. Andrew Fiore, a doctoral candidate at the University of California, Berkeley, who studies online dating, suggests that in a few years we will even be able to add physiological signs to the experience—the sound of your date’s heartbeat, perhaps?

Add community-based matchmaking to enriched virtual dating, and we have turned the Internet into the greatest yenta the world has ever known. **M**

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*The pursuit of happiness drives much of what we do, but achieving it always seems just out of reach*

# Why It's So Hard to Be

# HAPPY

**By Michael Wiederman**

What would make you happier? Perhaps a bigger house or a better car; a sexier or more understanding mate; surely, wealth and fame. Or maybe you would simply be happy with finishing everything on your to-do list. Well, stop deluding yourself. Psychological research suggests that none of these things is very likely to increase your happiness significantly.



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Despite being far better off financially than previous generations, **we are no happier.**



Some people are naturally happier than others, thanks mainly to genetic differences. Happy people tend to be extroverted and to have a feeling of personal control over their lives.

Take money, for example. Using data from the 2000 U.S. Census, David G. Myers documented an interesting discrepancy between wealth and happiness. Myers, a psychologist at Hope College in Holland, Mich., found that the buying power of the average American had tripled since 1950. So were Americans three times happier in 2000 than 50 years earlier?

The National Opinion Research Center at the University of Chicago has asked Americans to rate their level of happiness in surveys that have been conducted most years since 1957. When Myers compared these surveys with the economic data, he found that the proportion of Americans who describe themselves as “very happy” has remained remarkably stable at about one third. Despite being far better off financially than previous generations, we are no happier.

In fact, young Americans are more anxious than in the past. In 2000 Jean M. Twenge, a psychologist now at San Diego State University, published a sweeping analysis of 269 studies conducted between 1952 and 1993—all of which had measured the anxiety levels of children or college students. When Twenge correlated the measurements with the dates of the studies, she found a strong linear increase in reported anxiety over time. The average American child in the 1980s reported more anxiety than child psychiatric patients of the 1950s.

Psychologists have long studied anxiety and depression, but in recent years they have also begun exploring the nature of what makes humans happy. The field of “positive psychology” is now a burgeoning one, and its results have led to some surprising conclusions. There is a growing body

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of evidence that happiness is not something that can be achieved by hard work or good luck. The happiest people seem to be those who are fully engaged in the present, rather than focused on future goals. What can we do to increase the likelihood of being happy? The answers may lie in our biological past.

### Thanks for the Inheritance

When evolutionary psychologists notice a universal aspect of how people perceive the world, they make an assumption: that slice of human nature must have been adaptive for our distant ancestors. During our long evolutionary history, we passed certain characteristics to the next generation when the individuals who possessed them were more likely to survive and have offspring. Other ways of reacting to the world were weeded out, because the individuals who possessed brains wired to respond in those ways were less likely to survive or have offspring.

What does natural selection have to do with happiness? We humans have inherited a remarkable capacity to habituate to, or become accustomed to, the status quo. Habituation is wonderfully adaptive when we are faced with adverse conditions, such as chronic noise or a permanent disability. After a while, we may no longer even notice these unpleasant circumstances. Unfortunately, habituation applies to positive aspects of our lives as well. No matter how pleasant an experience is at first, if it becomes a constant, we habituate to it.

We have also inherited a tendency to notice the negative more readily than the positive. Those early *Homo sapiens* who were most sensitive to negative changes in the environment were probably most likely to survive, because negative changes may have signaled danger. Like our distant relatives, we, too, have brains that are wired to notice trouble. So the natural human condition is to take positive experiences for granted and to focus on the bothersome aspects of life.

Last, one other aspect of human nature helps to prevent us from being satisfied: that little voice inside our head that often convinces us that our life would be better if only we possessed or accomplished something else. It is easy to see how early humans who were never quite satisfied would have had an advantage over their more easily satisfied peers. That nagging voice of dissatisfaction would have prompted our ancestors to strive for a bit more and then a bit more after that.

Today we all share a certain set of human

## How to Be Happier

**1 DO NOT FOCUS ON GOALS.** Even though you may intellectually reject the idea that happiness can be achieved or bought, you must be constantly vigilant against that internal voice that whispers, “But I would be a bit happier if only ...” One strategy to try is to reflect on those times when you were convinced that a certain accomplishment or possession would bring greater happiness, yet your life was not significantly different after you reached your goal. How many times have you had this experience? How many more are needed to finally convince you that it does not work that way?

**2 MAKE TIME TO VOLUNTEER.** People who volunteer to help those in need tend to report being happier. Perhaps it is because working with those less fortunate makes you grateful for what you have. Also, volunteering often brings satisfaction and self-esteem, because you feel engaged in worthwhile work and are appreciated by those you serve. Do not compare yourself with others who seem better off than you are, because that usually results in dissatisfaction.

**3 PRACTICE MODERATION.** If you grow too accustomed to pleasurable things, they will no longer bring you happiness. For example, you may enjoy two or three short vacations more than one long one. And you will enjoy your favorite meal more if you reserve it for a special occasion.

**4 STRIVE FOR CONTENTMENT.** Rethink your beliefs about the nature of happiness. Experiences of great pleasure or joy stand out in memory, and it is easy to conclude that being truly happy means being in that state most or all of the time. The very reason you savor and remember such an experience, however, is because it is not the norm. Instead of equating happiness with peak experiences, you would do better to think of happiness as a state of contentment and relative lack of anxiety or regret.

**5 PRACTICE LIVING IN THE MOMENT.** Start small by focusing on your sensory experience while engaged in a routine task. Over time, spend less energy thinking about the past or the future.

characteristics that prime us to be on a perpetual search for a better life. But that does not explain why some people seem to be happier than others. We might assume that happy people are those who have finally achieved the good life. Psychologists, however, have learned that happiness is more closely tied to personality than to life experiences.

### The Power of Personality

Personality differs from human nature in that it varies across individuals. At the same time,

(About 80 percent of the variation in happiness among individuals was attributable to **genetic differences**.)

Happy people tend to engage in activities that are challenging and absorbing. Such activities, dubbed “flow” experiences, force people to focus their full attention on the present moment.

personality is relatively stable across each person’s lifetime. Events come and go, but our traits and habitual ways of responding remain.

When it comes to happiness, events influence how we feel, at least in the short run. Winning the lottery is liable to prompt even the most cynical individual to experience a sudden spike in happiness. Still, people habituate to the way things are and fall back to their personal baseline level of happiness. It is this inherent baseline, or set point, of happiness that is an aspect of personality. So why do different people have different set points for happiness?

A study of twins published in 1996 points to the answer. Researchers Auke Tellegen and the late David Lykken of the University of Minnesota compared the similarity in happiness scores among sets of identical and fraternal twins who grew up together or were reared apart. These

comparisons enabled the researchers to determine the degree to which variations in happiness are related to variations in our genes. They found that about 80 percent of the variation in happiness among individuals was attributable to genetic differences.

When most people hear the word “genetic,” they tend to think “passed from parents to offspring.” In this case, however, “genetic” refers to a characteristic arising from the novel way genes come together to form each unique individual. This fact explains why traits that have a strong genetic component may still vary widely between parents and their children or between siblings. Unless an individual has an identical twin, that person is truly one of a kind genetically.

The notion that each of us has an inherent baseline of happiness—largely determined by our genes—has important implications when com-



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bined with our shared human nature. The tendency to habituate to the status quo explains why, no matter what happens in our lives, we tend to return to our own individual set point of satisfaction with life.

Psychologists have discovered a number of personality traits that seem to be common in people with high set points of happiness. In a 1998 paper, social psychologist Kristina DeNeve of Baylor University (now at Creighton University) and psychologist Harris Cooper of the University of Missouri–Columbia (now at Duke University) reviewed 148 studies of the relation between personality and happiness. Perhaps not surprisingly, they found that people who reported being happier also reported being more extroverted, friendly, trusting and conscientious. Happier people were also more likely to believe they had control over their lives and were less prone to anxiety and mood swings.

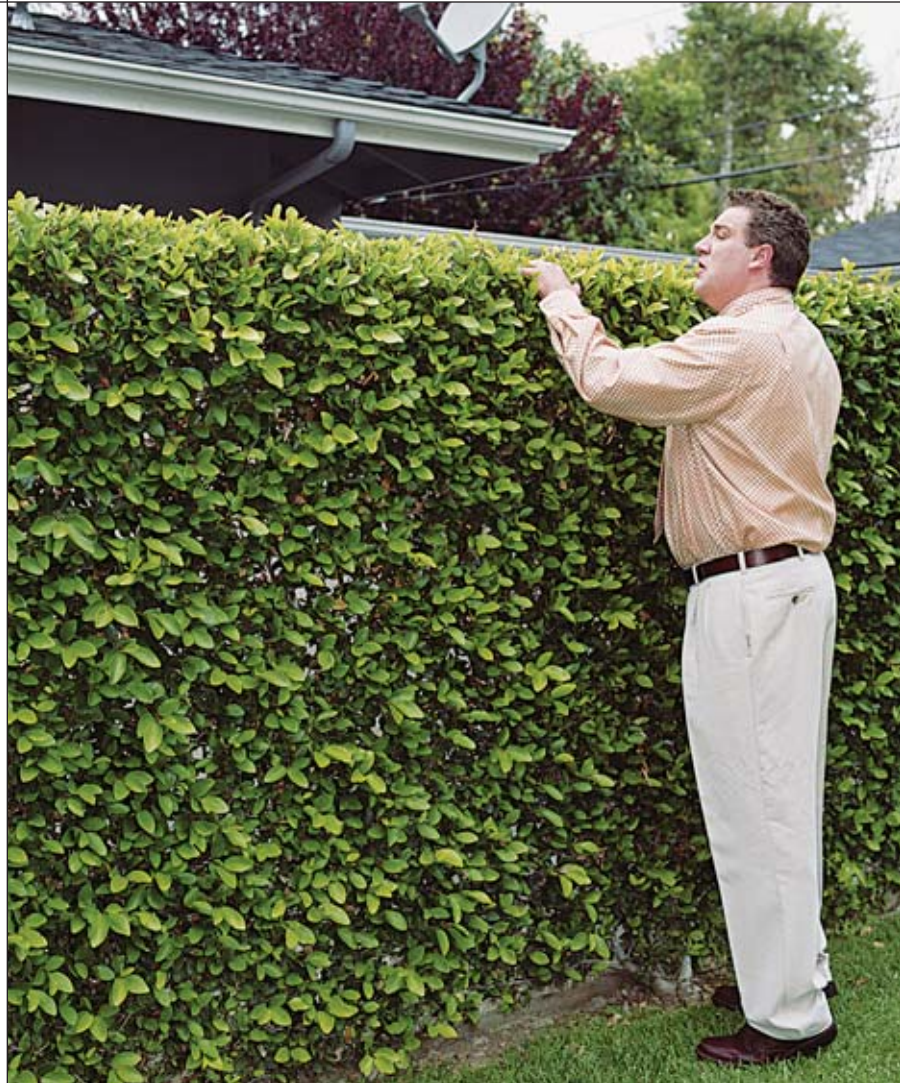
The personality traits associated with happiness seem to be characteristics that are also related to personal success and achievement. Can happiness (or at least satisfaction) be won through hard work and determination? After all, isn't that the core belief underlying the American dream?

### Goals + Achievement = Happiness?

American capitalism rests on the assumption that we can achieve or buy happiness, a belief that fuels competition and consumerism. The research showing a lack of correlation between wealth and happiness casts doubt on this assumption. But competing for wealth is more than just an unproductive way to achieve happiness; it is a recipe for unhappiness.

Psychologists refer to our tendency to compare ourselves with those who are better off as "upward comparison," and it is known to engender dissatisfaction. Using data from U.S. surveys conducted by the National Opinion Research Center between 1989 and 1996, Michael R. Hagerty of the Graduate School of Management at the University of California, Davis, studied the relation between happiness and the distribution of wealth in one's community. He found that the greater the income disparity within a community, the less its residents were satisfied with their lives. Analyzing data from the U.S. and seven other nations collected between 1972 and 1994, Hagerty found that as the inequality of income lessened within a particular country, the average level of life satisfaction increased.

It seems that when we are aware that others



are better off than we are, our own satisfaction suffers. Conversely, downward comparison (to those who are worse off than we are) tends to make us more appreciative and satisfied. The bad news? Upward comparison seems to come more naturally, a tendency that may be fueled by the mass media.

Even when we are not competing directly with others, our tendency to link happiness to the achievement of goals is counterproductive. Although more research is needed, psychologists William D. McIntosh of Georgia Southern University and Leonard L. Martin of the University of Georgia have theorized that people who re-

**Trying to keep up with the Joneses? Psychologists warn against comparing yourself with others who are more fortunate.**

### (The Author)

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# ( Success is related to happiness—but as a consequence, not a cause, of mood. )

People who link happiness with goal achievement are setting themselves up for trouble. Unmet goals can cause anxiety, and fulfilled goals are quickly forgotten.



peatedly focus on attaining goals are less likely to be happy.

We might think of each person as falling somewhere along a continuum of linking happiness with goal attainment: from “nonlinker” to “strong linker.” McIntosh and Martin say the problem with being a strong linker is the tendency to then be obsessively focused on meeting specific goals. Because of the belief that happiness depends on reaching those goals, strong linkers tend to experience anxiety and pressure as long as the goals remain unmet. They believe that happiness will be attained only at some future point. But what about when their goal is finally achieved?

After cherished goals are realized, habituation takes over, and strong linkers return to their previous baseline level of happiness just like everyone else. But when a strong linker realizes that his or her level of happiness has not permanently changed, the person typically concludes that happiness lies just over the next horizon.

Psychologists have found that we humans are good at deceiving ourselves about the future. We tend to believe that our prospects for increased happiness are better than our current circumstances. This tendency is nurtured by the media and advertising, which promise greater satisfaction with certain purchases or successes. People

who persist as strong linkers tend to choose new goals, convinced that this time they have found the “real” path to happiness.

The choice to continue to link happiness to achievement of goals may be bolstered by observation. Doesn't it seem that successful people are happier? Research supports such a connection, but not in the way we usually assume.

In 2005 Sonja Lyubomirsky, a psychologist at the University of California, Riverside, and her colleagues reviewed the results of studies showing a positive correlation between happiness and success. They also examined longitudinal studies—in which happiness was measured both before and after some specific success—as well as experiments in which pleasant, neutral or negative feelings were induced in participants before the start of some task. In both types of research, happiness and positive mood were important as precursors to success. Happy people were not necessarily happier after their success than they were before, but they tended to be happier than others who were less successful.

Lyubomirsky concluded that success is related to happiness—but as a consequence, not a cause, of mood. The most likely explanation is that happy people have other personality traits that facilitate success. Also, a positive mood is liable to result in greater motivation, as well as cooperation from others. But how can you achieve happiness (and the success that comes with it) if your personality is not naturally sunny?

## Go with the Flow

Mihaly Csikszentmihalyi, a psychologist at Claremont Graduate University, has concluded that the people who tend to be happier are those who report experiencing what he calls “flow.” Csikszentmihalyi coined the term in a 1975 book that was based on hundreds of interviews. He has since published several other books on flow, which he defines as experiences that are inherently interesting and motivating for an individual because he or she becomes totally absorbed in them. That is not to say that flow experiences have to be fun (although frequently they are) but rather that flow involves being fully engaged. The task at hand is not too boring or too frustrating; it is sufficiently challenging to require one's full attention.

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By incorporating the notion of flow, Western psychology has embraced the Eastern concept of mindfulness, which requires its practitioners to be nonjudgmental and conscious only of the present—immersed in what is happening right now. Unfortunately, this state of mind is not the norm for most of us; it is a skill that requires practice—through meditation, for example.

Why do people who report experiencing more flow also tend to be happier? Prominent psychologists, from Carl Rogers to Fritz Perls, describe psychological health as living in the present moment. Perhaps the link between happiness and flow has to do with the fact that flow experiences demand complete attention to the present. When we are totally engaged in what we are doing right now, it is impossible to focus on the past or future or to feel self-conscious—all of which tend to undermine satisfaction with life.

The growing body of research on happiness

does not point to any easy answers. The roots of happiness are tangled, but understanding the inherent ways that our minds work does afford us the chance to make better choices about how we will invest our effort and time in the pursuit of happiness. Research from psychology seems to support what so many nonpsychologists have said before: happiness is not an ultimate destination but instead lies in appreciation of the journey. **M**

People who do volunteer work tend to be happier, perhaps because of “downward comparison” with others who are less fortunate.

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# JUMPING TO CONCLUSIONS

Can people be counted on to make sound judgments?

By  
**Deanna  
Kuhn**

**A** four-year-old watches as a monkey hand puppet approaches a vase containing a red and a blue plastic flower. The monkey sneezes. The monkey backs away, returns to sniff again, and again sneezes. An adult then removes the red flower and replaces it with a yellow one. The monkey comes up to smell the yellow and blue flowers twice and each time sneezes. The adult next replaces the blue flower with the red one. The monkey comes up to smell the red and yellow flowers and this time does not sneeze.

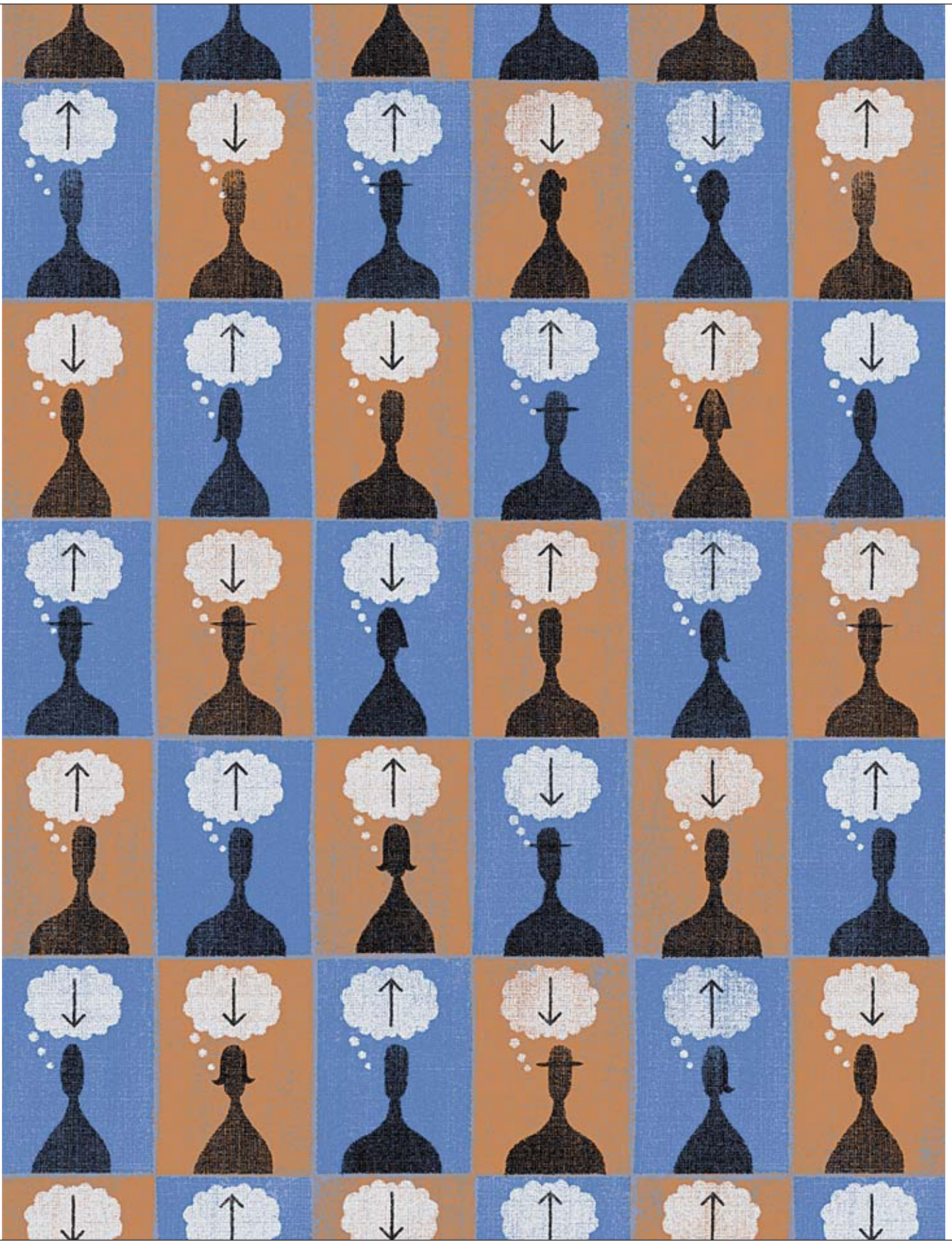
The child is then asked, “Can you give me the flower that makes Monkey sneeze?” When psychologists Laura E. Schulz and Alison Gopnik, both then at the University of California, Berkeley, did this experiment, 79 percent of four-year-olds correctly chose the blue flower. As their research makes clear, even very young children have begun to understand cause and effect. This process is critical to their ability to make sense of their world and to make their way in it.

With such powers of discernment already

in place by age four, people should be highly skilled at identifying cause and effect—causal reasoning—by the time they are adults, shouldn’t they? Indeed, a substantial body of contemporary research suggests that is the case, highlighting the nuanced judgments adults are capable of—such as making consistent estimates, across different circumstances, of the numerical probabilities that two events are causally related.

Here I present some evidence that gives a very different impression: the everyday causal reasoning of the average adult regarding familiar topics appears highly fallible. People connect two events as cause and effect based on little or no evidence, and they act on these judgments—they jump to conclusions. By learning more about precisely how they do so, researchers can develop ways to improve thinking. Such efforts could help educators in their mission to inspire solid, careful thinking in young minds.

A possible explanation for the discrepancy between our findings and much of the relevant literature is that researchers studying



# Case Studies in Cause and Effect



In a study, adults had difficulty judging which factors yielded the best performance at fund-raising parties. The results provided (*below*) showed a causal relation between “auction” and sales (compare first and third parties) and no causal relation between “comedian” and sales (compare second

and third). Information was insufficient to determine other feature effects. Yet 83 percent of the volunteers said two or more features increased sales, and 45 percent claimed three or all four did so. Most also reported feeling certain about the correctness of their (often erroneous) judgments.

### First party

- Door prizes
- Comedian
- Costumes

**SALES: MEDIUM**

### Second party

- Door prizes
- Auction
- Costumes

**SALES: HIGH**

### Third party

- Door prizes
- Auction
- Comedian
- Costumes

**SALES: HIGH**

A second reasoning task asked volunteers to make predictions, all of which were indeterminate (because the effects of door prizes and costumes were unknown). Respondents displayed inconsistent logic. Particularly difficult for them was recognizing that a feature whose presence had a positive influence on an outcome would negatively affect the

outcome when it was removed. For example, in the prediction question involving door prizes and a comedian (*lower left*), only 40 percent of respondents circled the absence of an auction as affecting the outcome, although 85 percent had correctly labeled it as causal. As before, people were nonetheless certain about their judgments. —D.K.

- Door prizes
- Comedian
- Auction

**SALES: LOW MEDIUM HIGH**

#### How certain are you? (circle one)

Very certain                      Certain  
Think so but not certain      Just guessing

#### Which influenced your prediction? (circle as many as apply)

- Door prizes
- Auction
- Comedian
- Absence of costumes

- Auction
- Comedian
- Costumes

**SALES: LOW MEDIUM HIGH**

#### How certain are you? (circle one)

Very certain                      Certain  
Think so but not certain      Just guessing

#### Which influenced your prediction? (circle as many as apply)

- Auction
- Costumes
- Comedian
- Absence of door prizes

- Door prizes
- Comedian

**SALES: LOW MEDIUM HIGH**

#### How certain are you? (circle one)

Very certain                      Certain  
Think so but not certain      Just guessing

#### Which influenced your prediction? (circle as many as apply)

- Door prizes
- Comedian
- Absence of auction
- Absence of costumes

- Auction
- Costumes

**SALES: LOW MEDIUM HIGH**

#### How certain are you? (circle one)

Very certain                      Certain  
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#### Which influenced your prediction? (circle as many as apply)

- Auction
- Costumes
- Absence of comedian
- Absence of door prizes

causal reasoning skills in adults have typically based their conclusions on studies of a narrow segment of the adult population in a specific context—college students in laboratory settings performing complex paper-and-pencil tasks. In a 2000 study, for example, psychologists Patricia Cheng of the University of California, Los Ange-

paring the second and third parties, you can see that adding a comedian has no effect on sales. Yet the information available is insufficient for assessing the causal status of door prizes or costumes (because they are always present).

Did this diverse group of adults at Penn Station show as much skill in isolating cause and ef-

## Do studies represent the cognitive performance of average people in their thinking about everyday affairs?

les, and Yunnwen Lien of the National Taiwan University in Taipei presented college students with a set of instances that described the blooming frequencies of plants that had been fed plant food of different shapes and colors. After examining each case, students rated on a numerical scale the likelihood or degree of causal influence of each of the factors and/or made predictions regarding outcomes for novel instances—and showed good reliability in doing so. Although such studies highlight the skills that college students display in such tasks, do they represent the cognitive performance of average people in their thinking about everyday affairs?

To address this question, my student Joanna Saab and I went last year to New York City's Pennsylvania Station. We asked 40 people seated in the waiting room if they would spend 10 minutes answering a survey in exchange for five dollars. Virtually all accepted. We explained that a group was trying different combinations of entertainment features at fund-raisers, to see which would sell the most tickets, and showed each person a diagram with some of the results. The sign for the first party listed door prizes, comedian, costumes; its sales were "medium." The second party listed door prizes, auction, costumes; its sales were "high." The third party listed door prizes, auction, comedian, costumes; its sales were "high."

We left the diagram in view as we talked to each of our interviewees, and we asked, "Based on their results, does the auction help ticket sales?" We also asked how certain they were about their answers. They could choose "very certain," "certain," "think so but not certain" or "just guessing." We asked the same questions for each of the three remaining features: comedian, door prizes, costumes.

As you can deduce for yourself [see box on opposite page], if you examine the first and third parties, adding the auction boosts sales. By com-

fect as researchers have attributed to college students? Or even the same degree of skill as the four-year-olds described earlier? In a word, no. Overall, they claimed more causal relationships to be present than the evidence justified. Eighty-three percent judged that two or more of the features caused sales to increase, and 45 percent claimed that three or all four of the features did so (remember, the available evidence supported a relation between only one feature—auction—and outcome). Even more striking, most respondents were quite confident that they were correct. For two of the four features, the average certitude reported was greater than "certain" (and tending toward "very certain"), whereas for the other two the average was slightly below "certain." Gender was not a factor: men and women did not differ significantly in either their judgments or levels of certainty.

What made these respondents so sure about which features affected outcome and which did not? We emphasized to them that they should base their conclusions on the results shown for the particular group of people indicated (rather than on their own prior beliefs about the effectiveness of these features); in response to a follow-up query at the end, all respondents indicated that they had done so. Yet their responses revealed that their judgments were in fact influenced by their own ideas about how effective these features ought to be. Respondents judged door prizes to affect outcome (83 percent did so) much more commonly than they judged costumes to affect outcome (33 percent did so), although the evidence with respect to the two features was identical.

To gain further insight, we presented respondents with an additional task [see box on opposite page].

In this second case, there were no correct answers. One cannot make justifiable predictions

given the indeterminate causal status of two of the features: door prizes and costumes. Nevertheless, respondents' certainty regarding the predictions they made remained as high as it had been for their causal judgments. Their predictions, moreover, were informative. For example, to infer whether a respondent judged the auction feature as causal, we compared the predictions the person made for a particular pair of cases—specifically, those two cases that involved door prizes. If the auction was being regarded as causal, predictions for these two cases (one with the auction present and the other with it absent) should have differed. If the auction was being regarded as noncausal, its presence or absence should have had no influ-

motivated to answer the questions to the best of their ability to justify receiving their five dollars. But they were unlikely to focus on the task as a reasoning test, designed to assess their mental processes, as readily as would college students, who have become familiar with such tests. The purpose, which most college students recognize, is not to achieve a solution (whether it be maximizing ticket sales or designing a bridge sufficient to support a given weight) but rather to display how they go about tackling the problem. College students have learned to behave accordingly, looking at the information given and determining how they should use it to produce an answer. Unsurprisingly, then, we found that re-

## Aren't people most likely to come to the best conclusions if they make use of all they know?

ence and predictions for these two cases should have been identical. Similarly, comparing the predictions for the two cases involving costumes allowed us to infer whether the respondent judged the comedian as causal.

The implicit judgments that respondents made in the prediction task tended to be inconsistent with the causal judgments they had made in the judgment task when they were asked to indicate explicitly whether a factor was causal ("helped ticket sales"). Only 15 percent made consistent judgments across both tasks. Similarly, people were inconsistent in the implicit causal attributions they made in response to the questions about which features had influenced each of their predictions. Among the 63 percent who had correctly judged the inclusion of a comedian as having no causal effect in the judgment task, for example, a majority nonetheless indicated that the presence or absence of a comedian had influenced their predictions. Particularly difficult was recognizing that a feature whose presence positively affected an outcome would negatively affect the outcome when it was removed.

### Reconciling the Inconsistencies

How can we reconcile the inconsistent and incautious causal judgments made by people waiting in a train station—judgments they claimed to be certain of—with the reasoning skills observed in college students and even four-year-olds? The answer is invariably multifaceted. Our respondents took the task seriously and were

spondents with a college background made sounder judgments than those without it did.

Those who do not possess this "academic" mind-set, in contrast, tend to focus on getting the problem solved and allocate little attention to the mental operations they use in the process. In getting to a solution, they bring to bear everything they know that might be of use. Based on their own prior knowledge that door prizes seem more likely to be a winner for fund-raising than costumes, they judge door prizes as causal—even though the presented evidence provides no support for this difference. Keeping track of how they responded in an earlier part of the interview, so as to maintain consistency, will not help solve the problem and thus is not a high priority. For such people, the best reading of how things look at the moment is what is important. Once a decision is reached, moreover, expressing confidence and certainty is better than wavering.

So who is using the "smarter" approach? Why put old beliefs on hold when evaluating new information? Aren't people most likely to come to the best conclusions if they make use of all they know while reaching them? In many contexts, the answer is yes. Yet being able to evaluate "the information given" to determine exactly what it does (and does not) imply is also an important skill—and not just within the rarefied halls of academia.

Suppose, for example, I am thinking about trying the new weight-loss product my friends are talking about, but they tell me they have





heard it could cause cancer. When I go to the medical library to look up a recent study on the product, I want to be able to interpret what it says, independent of prior thoughts I may have. In reaching a decision, I may ultimately integrate what the report says with other considerations. But I could not do so were I not able to interpret the document in its own right.

In his 2004 book, *The Robot's Rebellion*, Keith E. Stanovich of the University of Toronto similarly makes the case for the importance of what he calls “decontextualized” reasoning and describes studies in which participants fail to use it. The relevance of such reasoning is by no means limited to thinking about causality. Reaching a verdict in a legal trial, for example, is one common context in which jurors are required to rely on the presented evidence alone, not on everything that comes to mind related to this evidence. So is deductive reasoning, employing ancient Greek philosopher Aristotle’s classical syllogisms. Stanovich notes, for example, that 70

percent of adult subjects accepted this syllogism as valid:

**Premise 1:** All living things need water.

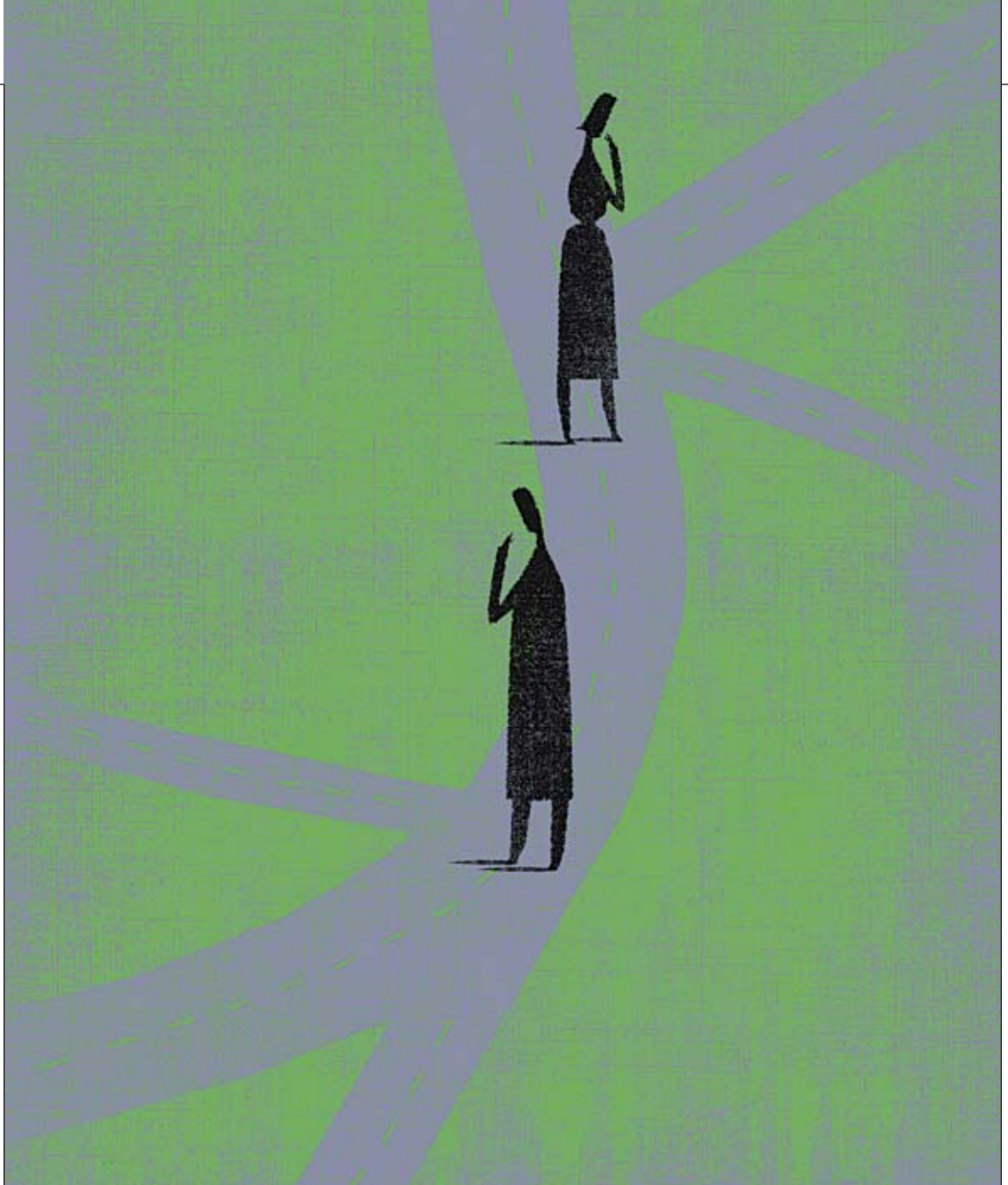
**Premise 2:** Roses need water.

**Conclusion:** Roses are living things.

Because we know the conclusion to be true in the real world, it is easy to accept, even though it

### (The Author)

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does not follow logically from the premises. To be convinced of this fact, we need only compare it with a syllogism identical in form:

**Premise 1:** All animals of the hudon class are ferocious.

**Premise 2:** Wampets are ferocious.

**Conclusion:** Wampets are animals of the hudon class.

Typically only 20 percent of people accept this conclusion as correct. The other 80 percent correctly reject it, the improvement in performance presumably arising because no obfuscating real-world knowledge got in the way.

As the research we conducted at the train sta-

tion suggests, decontextualization is not the only skill in the careful reasoner's mental tool kit. Consistency and avoiding undue certainty in one's judgments are also important. Undue certainty reflects a failure in "knowing what you know" (also called metacognition) and underlies the rigidity in thinking that is a major contributor to human strife. Inconsistency can be similarly self-serving, allowing us to protect our favorite theories without subjecting them to the same standards of evidence to which we subject those of others. We maintain that superior skill was the cause of our team's victory, whereas the other team's win was because of luck.

The authors made no assessment of consistency or certainty of the causal judgments of the four-

JIM FRAZIER Getty Images

year-olds in the study described earlier. But we can see why these children may have had an easier time evaluating evidence than the adults in our study had. The scenario involving different colored flowers engaged very little in the way of prior knowledge regarding which colors would be more likely to make a monkey sneeze. The adults, in contrast, had much prior experience that they could bring to bear on matters of event planning, ticket sales and the enjoyableness of different activities. This

nable to improvement, and with practice it becomes more careful and critical. Performance on standardized tests of “basic skills” of literacy and numeracy has come to occupy center stage as a measure of how successful schooling has been at teaching students what they need to know. In contrast, learning to make sound judgments about matters of the kind people encounter in everyday life has not been a high priority as an objective of education.

## ( Rich knowledge can make it more challenging to evaluate evidence in its own right. )

rich knowledge made it more challenging for them to evaluate the evidence in its own right.

What the competence displayed by the subjects in Schulz and Gopnik’s study does show, however, is that the underlying reasoning processes entailed in multivariable causal inference (involving multiple potential causes) have developed to at least a rudimentary degree among four-year-olds. More important, this is competence that we can build on in devising the kinds of educational experiences that will help older children and adolescents, and even adults, become more careful causal reasoners.

Other research that my colleagues and I have done shows that both children and adults do come to reason more critically about causality if they are provided frequent opportunities to practice evaluating evidence and making causal judgments and predictions. Early adolescent students initially show the kinds of faulty multivariable causal reasoning that have been illustrated here. But if they engage with problems of this kind over the course of several months, their reasoning improves sharply. The same is true of young adults enrolled in a community college.

### Thinking Forward

The message we might glean from the research I have described is twofold. First, the causal reasoning of average adults regarding everyday matters is in fact highly fallible. People frequently make unwarranted inferences with unwarranted certainty, and it is likely that they act on many of these inferences.

Second, although people may leap to unwarranted conclusions in their judgments about causality, we should not jump to the conclusion that this is the way things must be. Thinking is ame-

Such aspects of cognition may be recognized as warranting more attention, as people today struggle to interpret escalating amounts of information about increasingly complex matters, some of which have implications for their very survival. By promoting the development of skills that will help them meet this challenge, we could enrich conceptions of what is important for students to learn. As noted earlier, frequent opportunity to investigate diverse forms of evidence and draw conclusions from them does strengthen reasoning skills. Even getting into the habit of asking oneself and others simple questions like “How do we know?” and “Can we be certain?” goes a long way toward the objective of sound, rigorous thinking.

In an era of escalating pressure on educators to produce the standardized test performance demanded by No Child Left Behind legislation, is it sensible for them to even think about undertaking anything more? Certainly young people must become literate and numerate. But in the end, what could be a more important purpose of education than to help students learn to exercise their minds to make the kinds of careful, thoughtful judgments that will serve them well over a lifetime? **M**

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The image shows a wooden desk with a dark pen lying on it. The word "seduced" is written in large, white, lowercase letters across the center of the desk. The background is a light-colored wall.

# seduced

**Scientists have uncovered key clues to a strange disorder that puts its victims to sleep without warning—often at their own peril. The science boosts hope for new treatments while shedding light on the secrets of sleep**

**M**any schoolchildren try to sneak naps at their desks to get through the boring parts of class. Rainer Schmitt, on the other hand, always fought hard to stay awake. He would nod off anyway—in virtually every class period. And it was never the teacher's fault. Since childhood, Schmitt has suffered from an unusual neurological disorder: narcolepsy.

Now a 56-year-old math teacher, Schmitt still struggles with overwhelming daytime sleepiness and fatigue, the hallmark symptom of narcolepsy. Instead of feeling awake

for 16 hours and sleepy for eight, as most people do, Schmitt, like other narcoleptics, wants to sleep every couple of hours during the day. Fleeting urges to nod off plague him. Eventually the desire to sleep is overwhelming, and then he may actually fall asleep, usually for a few seconds or up to several minutes. He may nod off in the middle of a lecture, meeting or conversation. He could even fall asleep at the wheel.

Narcolepsy afflicts one in 2,000 Americans—at least 150,000 people in this country—and possibly many more. People with the disorder typically do not recognize their sleepiness as a sign of a disease, experts say,



# by Sleep

By Joachim Marschall

so they do not consult a doctor. As a result, they are often diagnosed with the disorder 10 to 15 years after their first symptoms appear.

All of that time, studies have shown, people with narcolepsy suffer immensely at work and in their social relationships. Many are unemployed, because employers or potential ones often dismiss them as lazy and fail to provide the accommodations these people need to perform well.

German psychiatrist Carl Friedrich Otto Westphal first described narcolepsy in 1877, yet only recently have researchers begun to decipher the biological causes of this strange malady. Notably, they have pinpointed a

brain chemical that is conspicuously absent in the brains of narcoleptics. What is more, surprising new evidence suggests that narcolepsy may be an autoimmune disorder like type 1 diabetes or multiple sclerosis. The recent work has led to powerful theories about what has gone awry in narcoleptics' brains and to possible new remedies for this debilitating disorder.

## Living in Dreamland

Doctors usually diagnose narcolepsy by listening in on a person's brain at night. In a sleep study, or polysomnogram, electrodes pick up a subject's brain waves and muscle

**AM I AWAKE?**  
Narcoleptics struggle against sleepiness all day long ...

movements throughout the night, revealing the periods when the patient is awake or in the various stages of sleep.

During normal sleep, a person first enters so-called non-rapid eye movement (NREM) sleep, starting with the first stage and then passing through stages 2, 3 and 4, which are progressively deeper and more intense. After about 90 minutes, rapid eye movement (REM) sleep begins. The eyes shift rapidly under the eyelids, and the brain is active, creating dreams.

In contrast to this pattern, narcoleptics start REM sleep within a few minutes of dozing off, a phenomenon called sleep onset rapid eye movement period (SOREMP). Doctors consider SOREMP a diagnostic red flag. Narcoleptics also spend significantly more time in REM sleep than healthy people do. That is, they dream a lot—perhaps too much.

The long periods that narcoleptics spend in REM sleep may deprive them of deep sleep, the phase that is crucial to physical recovery and cell regeneration as well as feeling alert in the morning. Thus, narcoleptics' daytime drowsiness may stem largely from a failure in the mechanism that governs REM sleep.

Consistent with this idea, many narcoleptics appear to suffer REM sleep-like episodes in the daytime. They may see or hear dreamlike images or sounds just before falling asleep or just after awakening from their midday naps, for example.

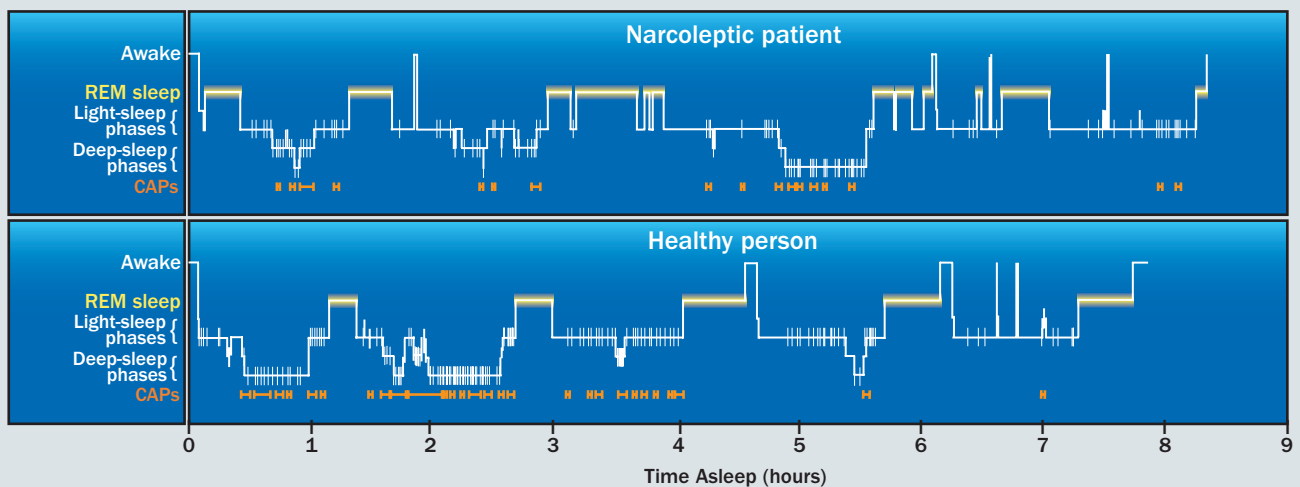
Curiously, many of them also experience bizarre muscle collapse, or cataplexy, that is reminiscent of the muscle slackening that occurs during normal REM sleep.

In cataplexy, strong emotions such as elation, surprise or anger may cause a narcoleptic's knees to buckle or his or her head to drop. In the worst cases, the entire muscle system fails, causing the person to fall down, paralyzed, for a few seconds to several minutes. "You collapse like a building hit by a bomb," Schmitt says. Similarly, in normal REM sleep, while the brain and eyes are active, the body is virtually immobile thanks to reduced muscle tone, something that may prevent people from acting out their dreams.

Narcolepsy may not just be a REM sleep disorder, however; narcoleptics also display certain oddities in NREM sleep, according to work reported in 2005 by neurologist Raffaele Ferri and his colleagues at the Oasi Institute for Research on Mental Retardation and Brain Aging in Troina, Italy. The Oasi investigators recorded bursts of brain activity called cyclic alternating patterns (CAPs) during NREM sleep in the brains of 49 narcoleptics, comparing them with 37 normal sleepers of the same age. The researchers recorded many fewer CAPs from the narcoleptics than from the normal sleepers, who typically have several hundred CAPs, each of which lasts just a few seconds, during the night. In addition to suggesting that NREM sleep is also im-

GEHRN&GEIST/SIGANIM; SOURCE: "NREM SLEEP ALTERATIONS IN NARCOLEPSY/CATAPLEXY," BY R. FERRI, S. MIANO, O. BRUNI, J. VANKOVA, S. NEVSIMALOVA, S. VANDI, P. MONTAGNA, L. FERINI-STRAMBI AND B. PLAZZI, IN *CLINICAL NEUROPHYSIOLOGY*, VOL. 116, NO. 11; OCTOBER 10, 2005

## A Rhythm of Their Own



The nighttime brain-wave patterns of a narcoleptic show an unusually high number of rapid eye movement (REM) sleep episodes (yellow) as well as much lower numbers

of cyclic alternating patterns (CAPs) (orange) and restorative deep-sleep phases, as compared with those of a healthy person.

paired in narcolepsy, such CAP frequency aberrations may be indicative of a sleeping process that is less restorative than a healthy sleeper's, the scientists suggest.

### Java Juice

Providing some of the first clues to the biochemical cause of such abnormal sleep, new studies are focusing on hypocretin, a tiny brain molecule produced by a cluster of only 10,000 to 20,000 cells packed at the back of the hypothalamus, a cone-shaped structure at the base of the brain. When hypocretin was first discovered in 1998, it was thought to be an appetite regulator, because this was the supposed job of that part of the hypothalamus. But since then, evidence has accumulated connecting hypocretin, or the lack of it, to narcolepsy.

Emmanuel Mignot, who leads the Center for Narcolepsy at the Stanford University School of Medicine, and his colleagues reported in 1999 that a mutation in the gene for one of the receptors that binds hypocretin caused narcolepsy in dogs. Meanwhile a team led by Masashi Yanagisawa of the University of Texas Southwestern Medical Center at Dallas showed that mice that could not produce hypocretin behaved just like narcoleptics. Mignot's group soon found that 90 percent of human narcoleptics lacked hypocretin in either their brain tissues or cerebrospinal fluid (the liquid that surrounds the brain). These studies, published in 2000, suggest that a lack of this neuropeptide causes narcolepsy and the accompanying flights into dreamland.

Exactly what function hypocretin plays in the body—and thus what is missing in narcoleptics—is still controversial. Some researchers suggest that hypocretin's role is to keep people awake and that, accordingly, narcolepsy results from inadequate stimulation of wake-promoting brain regions. This idea is consistent with the pattern of hypocretin secretion in the squirrel monkey, an animal with a sleep-wake cycle similar to that of humans.

A few years ago Mignot and his colleagues measured the amount of hypocretin in squirrel monkeys' brains during a typical day. They found a low level in the morning on awakening. Then the amount gradually rose, peaking at the end of the day just before the monkeys fell asleep. When the animals dozed off, the hypocretin level fell, eventually returning to the starting level. These results, reported by the Stanford team in 2003, suggest that hypocretin, though not promoting initial wakefulness, helps to maintain alertness



as the day wears on to counteract increasing fatigue. Without it, narcoleptics can remain awake comfortably only for a few hours.

A study in rats, reported in 2000, supports this view, while also helping to account for the abundance of REM sleep in narcoleptics. Biologist Luis de Lecea and his colleagues at the Scripps Research Institute in San Diego injected rats with hypocretin in a brain region ordinarily stimulated by hypocretin. The rats stayed awake 70 percent longer than usual. In addition, when the hypocretin-injected rats did sleep, they spent

**OR AM I DREAMING?  
... and their bodies  
often drop off  
to sleep without  
warning.**

### (The Author)

**JOACHIM MARSCHALL** is a psychologist working as a freelance science writer in Mainz, Germany.

# Top researchers suggest that narcolepsy may actually be an autoimmune disease like type 1 diabetes.

**Driving while drowsy: A narcoleptic may find himself literally asleep at the wheel.**

considerably less time in REM sleep than rats injected with saline did. Thus, hypocretin may maintain alertness at least in part by specifically blocking the excessive intrusion of dreams into a person's sleep-wake cycle.

But others say that hypocretin's job is to police the barriers between various states of consciousness so that the brain does not readily switch between them. Neurobiologist Thomas Scammell of Beth Israel Deaconess Medical Center in Boston, in collaboration with Yanagisawa and others, carefully measured and observed the sleep-wake cycles of a strain of mice that cannot produce hypocretin. Although the mutant mice spent normal amounts of time awake, asleep, and in REM and NREM sleep, like human narcoleptics they shifted with unusually high frequency among states of wakefulness, dozing, deep sleep and REM sleep.

This abnormal shifting was not because the

mice were unable to maintain alertness. Scammell's team found that under a stressful condition such as being put in a new cage—which typically induces heightened arousal—the mutant mice stayed awake just as long as normal mice, suggesting that alertness mechanisms are intact even in the absence of hypocretin.

## Death in the Brain

Scientists are also making headway in explaining the lack of hypocretin in narcoleptics. Research has shown that narcoleptics have only about 10 percent of the normal number of hypocretin-producing cells in their hypothalamus. Their lack of such cells may reflect a problem with their immune systems.

People carry different types of immune system proteins, called human leukocyte antigens (HLAs), on the surface of their white blood cells. Many autoimmune disorders, in which the immune system mistakenly attacks healthy body tissues instead of, say, infectious microbes, are associated with a distinctive set of these molecules.

In the 1990s Mignot and his colleagues discovered that about nine out of 10 patients with sleep-wake disturbances bore the HLA subtype HLA-DQB1\*0602, which is less common in healthy sleepers. This finding, according to Mignot and his Stanford colleague Seiji Nishino, suggests that narcolepsy may be an autoimmune disorder: narcoleptics' immune systems may mistakenly attack and destroy their hypocretin-producing cells. Additional research supports this view. For instance, researchers have been able to induce certain features of narcolepsy in mice by injecting them with immune system proteins from narcoleptics.

Both genetic and environmental factors are thought to underlie the development of narcolepsy. One to 4 percent of children with a narcoleptic parent will develop this disorder. Their risk is 20- to 80-fold higher than the incidence in the general population, suggesting that there are one or more genes that confer a risk of disordered sleep. One of them might be an immune component such as HLA-DQB1\*0602.

Genetics, however, cannot fully account for narcolepsy. About one fifth of the healthy population also carries HLA-DQB1\*0602. And if an





identical twin has narcolepsy, the other twin (whose genetic material is identical to that of his or her sibling) will develop the disorder only a third of the time.

Which environmental factors might tip the balance toward narcolepsy is still unknown. One possibility is stress. John Harsh of the University of Southern Mississippi, along with Dante Picchioni of the Walter Reed Army Institute of Research in Silver Spring, Md., asked patients with narcolepsy to describe what was happening in their lives just before they got sick. Compared with healthy volunteers surveyed about similar periods in their lives, a relatively high percentage of narcoleptics had experienced life-changing events—such as the birth of a child, getting a new job or moving to a new home—in the months before the onset of narcoleptic symptoms. Thus, major life changes, and the accompanying psychological stress, may alter the immune system in ways that facilitate the emergence of the disorder.

Some researchers hypothesize that prenatal infections may play a role as well. At least two research teams—one including Mignot and the other led by Harsh—have established a connection between birth month and narcolepsy: the disorder is unusually common among people born in March and disproportionately rare in people born in September. Other neurological disorders follow similar patterns; multiple sclerosis clusters among people born between March and July, whereas epilepsy springs up more often among those born between December and March. Such patterns may result if infections that spur the development of neurological disorders during a certain stage of pregnancy are more likely during some times of year than others.

### Wake-up Calls

Preventing narcolepsy is probably an impractical goal. But medicine can help patients cope. Currently many narcoleptics take amphetamine-like stimulants to combat daytime sleepiness. Some require antidepressants to treat cataplexy and dreamlike hallucinations. Doctors also often prescribe behavioral interventions such as scheduling naps during a patient's sleepest times. Such remedies target symptoms, however, rather than the cause of the disorder, and the drugs are not without side effects.

Researchers hope that the discovery of hypocretin and its role in the disorder will lead to important new medications. Some say that the best approach most likely will be the replacement of missing hypocretin, although getting the mole-



Actor Isaiah Washington, who stars in the television series *Grey's Anatomy*, has helped promote awareness of narcolepsy. A close friend of his suffers from the disorder.

cule—or something like it—into the brain is a formidable challenge. Hypocretins are unstable molecules. They easily disintegrate in the bloodstream and digestive tract, so simply injecting or swallowing them will not be effective.

For now, Schmitt works around his narcolepsy. He can generally stay awake through the morning to teach. Then he divides up afternoons and evenings to accommodate his unusual napping needs. As a consequence, he may find himself wide awake at 3 A.M., sitting at his desk, correcting papers. "I have made my peace with my school," he says. And the school has made peace with its math teacher's sleep. **M**

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- ◆ Narcolepsy Network: [www.narcolepsynetwork.org](http://www.narcolepsynetwork.org)
- ◆ National Institute of Neurological Disorders and Stroke site on narcolepsy: [www.ninds.nih.gov/disorders/narcolepsy/narcolepsy.htm](http://www.ninds.nih.gov/disorders/narcolepsy/narcolepsy.htm)
- ◆ National Sleep Foundation information on narcolepsy: [www.sleepfoundation.org/sleeptionary/index.php?id=12](http://www.sleepfoundation.org/sleeptionary/index.php?id=12)
- ◆ Stanford University School of Medicine, Center for Narcolepsy: <http://med.stanford.edu/school/Psychiatry/narcolepsy>

# Abnormal Attraction

**MOST PEOPLE ARE REPULSED BY THE IDEA OF SEX WITH CHILDREN. BUT KEEPING CHILDREN SAFE FROM PEDOPHILES MEANS TRYING TO DISCOVER HOW THIS DISASTROUS CRAVING COMES ABOUT—AND HOW TO TAME IT  
BY PEER BRIKEN, ANDREAS HILL AND WOLFGANG BERNER**

**A** girl and a man are sitting on a park bench. She's staring into a book; he's staring at her. After a while they start to talk and get into a friendly conversation. "Would you like to sit on my lap?" he asks softly. The stirrings of sexual excitement are faintly audible in his voice.



Uncomfortable, moviegoers squirm in their seats. They are watching Nicole Kassell's *The Woodsman*, a 2004 movie about the life of a pedophile. After 12 years behind bars for child molestation, Walter is trying to make a new life for himself. He has his own apartment, holds a job and has recently married. But the path to a normal existence is difficult. His co-workers are suspicious and give him the cold shoulder; his sister and the police have nothing but contempt for him. Viewers wonder whether such a man can ever find redemption. Perhaps he should be permanently removed from society.

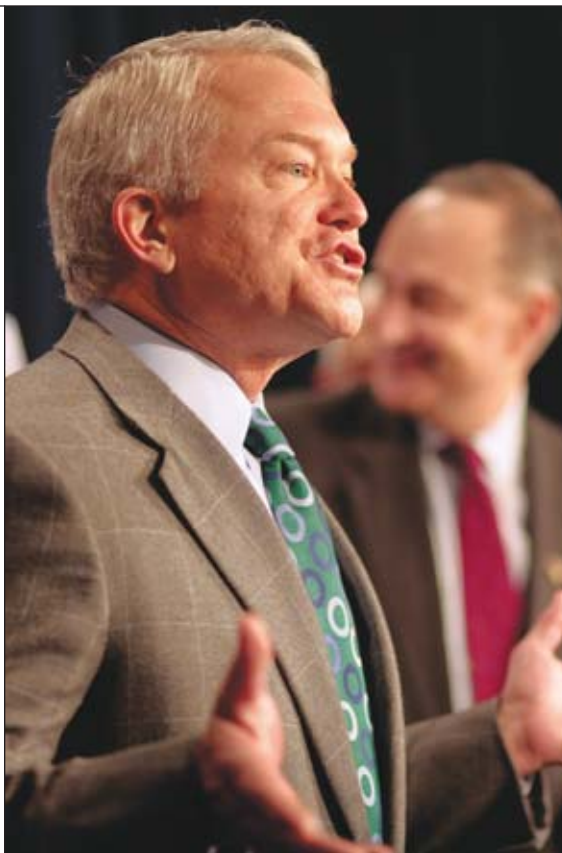
The public does not like to take chances with

MANFRED ZENTSCH Gehirn & Geist



**GUILT MEETS INNOCENCE**  
Pedophiles live in a constant struggle with their sexual urges. Most of them conceal their feelings their entire lives for fear of condemnation and punishment.

U.S. Representative Mark Foley of Florida resigned after being accused of sending sexually explicit electronic messages to current and former male pages, who were younger than 18 at the time.



pedophiles—people who are sexually excited by children. Some 89,000 children in the U.S. were sexually abused in 2002, according to the Department of Health and Human Services, and other studies suggest far higher numbers. Meanwhile one in seven youngsters aged 10 to 17 received an online sexual solicitation in 2005, reports the National Center for Missing and Exploited Children. Pedophiles are responsible for many of these solicitations and abuse cases. And among convicted pedophiles—especially those drawn to boys—the recidivism rate is high.

Yet not all adults who abuse children are pedophiles. Some of the abusers are not, in fact, especially attracted to children but target them because they are weaker and more pliable than adults. What is more, not all people who have pedophile tendencies act on them or turn violent. Indeed, given the consequences of being identified, many pedophiles remain undercover, surrounded by children while struggling with their secret desire.

And that can be dangerous.

Thus, some researchers are pushing the public to see pedophilia as a psychological disorder that calls for study and treatment—for no less a reason than the safety of children worldwide. The idea is to separate this mental state from criminal acts of child abuse, because the two do

not always go hand in hand. This tactic, after all, may be the only way to attract into treatment the untold numbers of undiscovered pedophiles and reduce the chances that any of them will ever harm a child.

### Officially Sick

In 1886 German psychiatrist Richard Freiherr von Krafft-Ebing coined the term “pedophile” (from the Greek *pais*, meaning “child,” and *philia*, meaning “love” or “friendship”). Krafft-Ebing was also one of the first to separate the desire for children from the behavior of child abuse. In his then revolutionary work, *Psychopathia Sexualis (Psychopathy of Sex)*, Krafft-Ebing opined that sexually deviant thoughts were not criminal per se but should in some cases be seen as an illness. Indeed, pedophilia is present in the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). This volume defines pedophilia as all recurrent sexually exciting fantasies, impulsive desires and behaviors that include sexual acts with a child and that occur over a period of at least six months.

Krafft-Ebing also pioneered a distinction between hard-core pedophiles—those whose predilection came to the fore at puberty—and other forms of child abuse in which children are used as substitutes for adults. These pedophiles turn to children later, after an adult relationship has failed or they realize that the possibility of one is remote.

Among the latter class are “situational molesters.” These people are usually incapable of having relationships with an equal—perhaps because of a mental disability—or may turn to children after experiencing frustration or humiliation in an adult relationship. In a subcategory called senescent pedophilia, for example, men target impressionable and compliant partners because of their own senility or increasing impotence. Situational molesters also include individuals who have ongoing contact with children because of their work, and thus may be drawn into situations in which they use their charges for their own sexual gratification.

### Love Gone Awry

Research into the causes and treatment of pedophilia remains somewhat fragmentary. One deterrent to such research is that scientists and clinicians who study and try to treat the condition are often branded as supporters of illegal sexual acts against children rather than as people trying to

KEN CEDENO Bloomberg News/Landov

understand and alleviate a psychiatric disorder.

Nevertheless, like other complex psychological traits, pedophilia is thought to stem from a combination of genetic and environmental factors. Many experts believe that disorders of sexual preference emerge from childhood experiences during critical periods in human development. In particular, several studies have confirmed that pedophiles are unusually likely to have been victims of violence and sex abuse as children. In one such study in 2001, researchers

may feel happiest and most secure when he spends much of his time with children and may even act childish himself.

Pedophiles often have other issues, too, according to Finkelhor, such as deep-seated sexual anxiety that blocks the development of normal sexuality. A general lack of inhibition rounds out the picture: pedophiles may suffer from psychosis, poor impulse control or alcoholism. Supporting the notion of pedophiles as impulsive, a research team led by psychologist Ronald Langevin of the

## Some 89,000 children in the U.S. were sexually abused in 2002, according to one study.

at the Royal Free Hospital School of Medicine and University College London reviewed the case notes of 225 male sex abusers and 522 other male patients being treated in a London clinic for sex offenders and sexual deviants. They found that abusers had themselves been victims of sexual violence considerably more often than the patients who had not committed sex abuse, suggesting a victim-to-perpetrator cycle in some men who commit sex crimes.

David Skuse and his colleagues at the Institute of Child Health in London went further, identifying other factors that push a male sex-abuse victim to commit a sex crime later on. Of 224 young male victims of sex abuse, 26 (12 percent) ended up committing sexual offenses, typically with children, by the time the researchers stopped following them seven to 19 years later. The victims who became perpetrators, the scientists reported in 2003, commonly had experienced neglect and lack of supervision, along with abuse by a female; often they had also witnessed violence among family members. Such a hostile childhood, psychoanalytic theory goes, can create a need to replace feelings of “defeat” with those of “triumph.” To accomplish this emotional shift, a person may turn the tables and become the sexual aggressor as an adult.

In other cases, however, the abused or otherwise troubled pedophile seeks less to dominate than to establish a “genuine” relationship with a child, opines sociologist David Finkelhor of the University of New Hampshire. Such men tend to identify strongly with the thought patterns and lives of children, a trait that often goes along with a lack of education and of self-esteem. In such cases of so-called emotional congruence, a man

University of Toronto discovered differences in an area of the frontal lobe in men who molest children as compared with normal men. This region of the brain is critical for impulse control among its other, higher-level reasoning functions.

### Biology to Blame?

In some cases, the roots of pedophilia may be less psychological than biological. For instance, preliminary data from 2002 link childhood brain trauma to pedophilia. A research team led by Ray Blanchard of the University of Toronto took the medical histories of about 400 pedophiles and 800 nonpedophiles and found that the pedophiles were more likely than the others to have had accidents causing loss of consciousness before age six. (Such accidents were also associated with lower intelligence and educational level.)

That does not necessarily mean that the early brain trauma caused the pedophilia, the authors note. It is possible that pedophiles are more likely to have been born with brain defects that can lead to pedophilia and that also made them accident-prone (and thus more likely to fall and hurt their heads). In that instance, the brain injury would simply be incidental to the pedophilia and not a cause of it. Other brain-based abnormalities—such as attention deficit-hyperactivity disorder (ADHD)—have been loosely associated with both pedophilia and being accident-prone. (Although

### (The Authors)

PEER BRIKEN is a physician and ANDREAS HILL is chief physician at the Institute for Sexual Research and Forensic Psychiatry at the Hamburg-Eppendorf University Clinic in Germany. WOLFGANG BERNER is a sex researcher, psychoanalyst and director of the institute.

# Correcting Pedophilia

“Don’t become a molester” is the slogan of a research and treatment project at the Institute of Sexual Science and Sexual Medicine that Klaus M. Beier leads at Charité Hospital in Berlin.

**SA Mind: Can pedophiles be changed?**

**Beier:** A person’s sexual preference can never be completely re-oriented; this includes his sexual orientation, age preference and predilection for particular sexual practices. Many disturbances or diseases can’t be cured per se, but they can be effectively treated. Take diabetes. A diabetic has to keep his or her blood sugar within a normal range, eat sensibly and exercise. Over time, he or she learns to pass by the doughnut shop or ice cream parlor. The same applies to sexual disorders: people who are affected have to learn to control their impulses so that they don’t harm themselves or others.

**SA Mind: How do you support your patients in this endeavor?**

**Beier:** It is counterproductive to blame these men for their sexual orientation and fantasies. But everyone is responsible for his own behavior. In our treatment program, we help patients develop strategies for avoiding sexual situations with children so that they don’t act on their fantasies. That said, patients must want to change. No one can be successfully treated against his will.

**SA Mind: Are pedophiles responsible for all child sex abuse?**

**Beier:** By no means. Many molesters are sexually attracted to adults. They act out on children because [the latter] can’t defend themselves the way adults can. Our

The program treats men who are sexually drawn to children. The goal is to prevent such men from ever acting on their attractions to minors.

—Interview by Sabine Kersebaum



Klaus M. Beier studies diagnosis and treatment of sexual preference and behavior disorders.

project is not geared toward this group of perpetrators.

**SA Mind: There are different types of pedophiles. Do you offer different types of treatment?**

**Beier:** There are basically two groups: those oriented exclusively toward children and those oriented toward both adults and children. Treatment is primarily based on inclusion in one of these groups rather than on personality factors.

**SA Mind: What are some of the differences in treating these two forms?**

**Beier:** Men who do not respond exclusively to children have better prospects for channeling their sexuality in socially acceptable ways. We foster this in treatment by, for example, including his partner in the process—if he in fact has one. Sometimes shyness and insecurity with women are behind a man’s sexual interest in children, for example.

For those who are exclusively attracted to children, we teach them to live responsibly with their predilection—that is, to come to terms with it while understanding that they can never act on this particular sexual desire.

**SA Mind: You’ve been talking exclusively about men. What about women?**

**Beier:** Although it is true that women are capable of and have committed child sex abuse, there is no such thing as a pedophile woman. At least I have never seen or heard of a single case over the course of my career.

pedophiles are more likely than others to have been diagnosed with ADHD as children, this does not mean that children with ADHD are likely to become pedophiles.) [For more on ADHD, see “Informing the ADHD Debate,” by Aribert Rothenberger and Tobias Banaschewski; SCIENTIFIC AMERICAN MIND, December 2004.]

Meanwhile, using family-history questionnaires, a team led by Fred Berlin at the Johns Hopkins School of Medicine found higher rates

of pedophilia among members of pedophiles’ immediate families than among the families of non-pedophiles. No one has found specific gene variants associated with pedophilia, however. Even if such genes are discovered, they are unlikely to fully account for the disorder.

**Getting Help**

Treatment for pedophilia typically involves a combination of talk therapy and medication. Psy-

COURTESY OF KLAUS M. BEIER

chotherapy can take one of two forms. Freudian psychoanalysis involves bringing to light traumatic events and identity crises from a patient's childhood so that such problems may be discussed and resolved. Cognitive-behavioral therapy, on the other hand, is geared more practically toward helping patients identify—and avoid—the kinds of situations that may tempt them to engage in harmful behaviors. Therapists may also try to correct a patient's cognitive distortions, such as the twisted notion that “the kid liked it.”

Sex offenders who successfully complete a psychological treatment program are less likely to commit another offense, or if they do reoffend the crime is typically not sexual in nature, write University of Leicester criminologist Charlotte Bilby and psychologist Belinda Brooks-Gordon of the University of London in a July 2006 review in the *British Medical Journal*. But not all pedophiles respond to psychotherapy, Bilby and Brooks-Gordon observe.

For additional help in subverting pedophilia, doctors may also prescribe medications such as selective serotonin reuptake inhibitors (SSRIs). These drugs are typically used to treat depression, anxiety and compulsive disorders, but can sometimes help pedophiles control their sexual urges. SSRIs boost the amount of the messenger substance serotonin in the brain; this boost is thought to have a positive effect on a person's emotional state. Our team reported in 2003 that these medications significantly decreased sexual fantasies, sexual desire and compulsive masturbation in pedophiles. These drugs, however, have not yet been proved to work against pedophilia in a clinical trial that compares them with a placebo.

Other promising medications target the hormonal regulatory system that is governed by a duet of small regions at the base of the brain: the hypothalamus and the pituitary gland. In one of their hormonal collaborations, the hypothalamus produces something called luteinizing hormone-releasing hormone (LHRH), which in turn causes the pituitary to release LH. LH then prompts the testes to produce and secrete the male sex hormone testosterone.

Drugs such as leuprolide acetate, a so-called LHRH analogue, can block this sequence of events and thus dramatically decrease testosterone production, reducing it to castration levels. Patients with deviant sexual tendencies are significantly less apt to act on their impulses when using these medications. In some cases, these drugs and others enable patients to feel suffi-



ciently unburdened to talk openly about their compulsive and often agonizing sexual fantasies and behaviors.

Ironically, successful treatment can bring about its own complications. Often helping men gain control over their deviant sexuality ends up forcing them to let go of a distortion that formerly propped up their self-esteem. As a result, patients confront a major personal crisis. At this point, a psychotherapist tries to help a pedophile find a suitable replacement for the emotional stability he had received from his pedophilic sexuality. But even then, the work is far from done. Most pedophiles must struggle to restrain their predilections for the rest of their lives. **M**

**Both psychotherapy and drug treatments can help prevent pedophiles from acting on their urges.**


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When it comes to understanding how acupuncture needles can heal, scientists are still only scratching the surface

By Susanne Kemmer

# Sticking Point

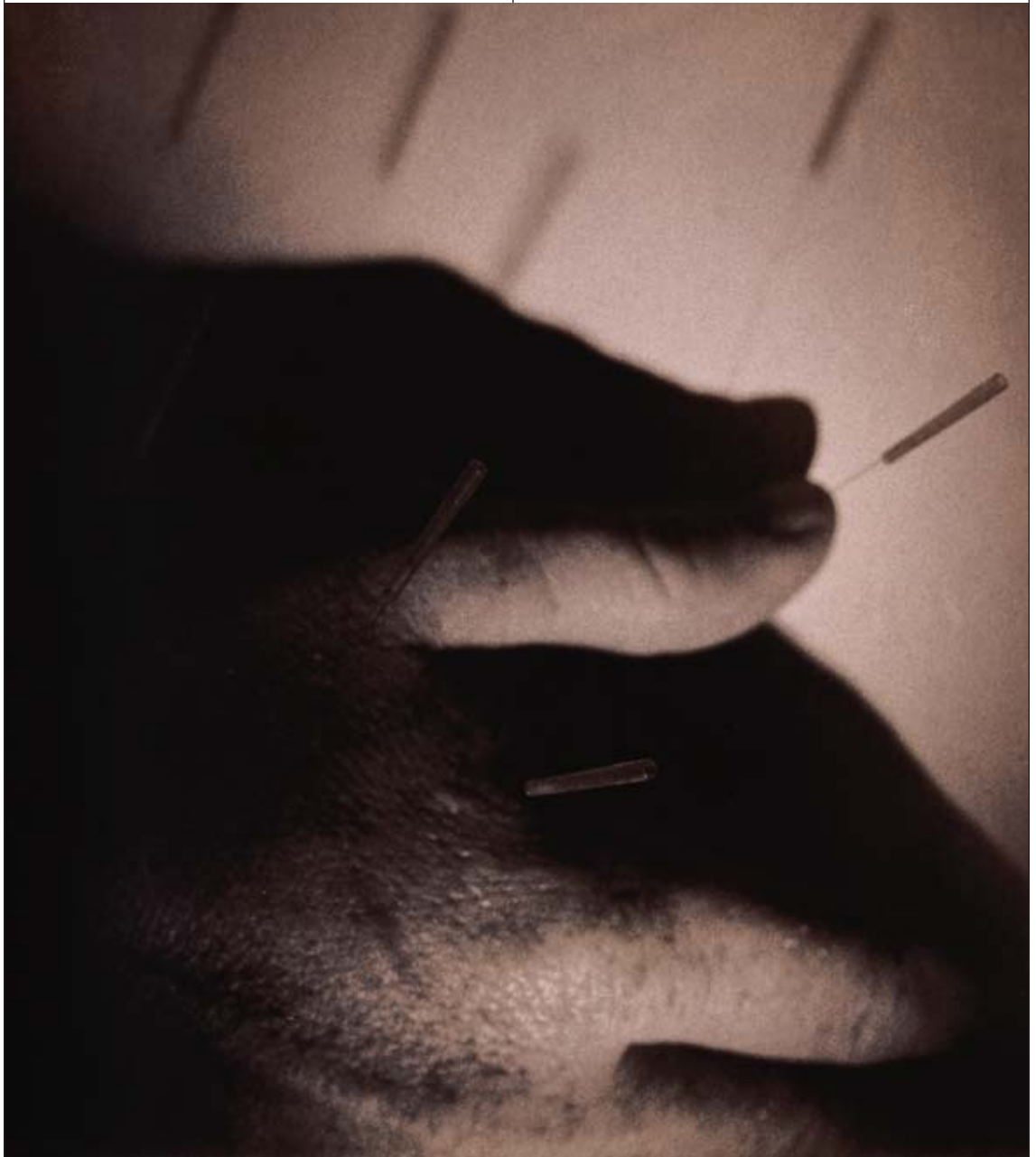
**T**he system of acupuncture can be traced back to China and has probably been practiced for thousands of years. The therapy became an international crossover hit much more recently. In 1972 President Richard M. Nixon visited the People's Republic, and the Western journalists accompanying him described spectacular successes of acupuncture in anesthesia and pain control—including cesarean sections in which the women got only needles and no anesthetics.

# Acupuncture has never been able to shake suspicions that it is merely an **esoteric sham treatment**.

Even as acupuncture has grown in popularity, though, it has never been able to shake suspicions that it is merely an esoteric sham treatment. Over the years, researchers have discovered that the simple act of placing a needle through the skin does seem to benefit some patients and trigger a surprising array of physiological activity. But it is also clear that the technique may have powerful placebo effects that could explain its success. Sorting out the relative contributions of

neurobiology and psychology to acupuncture's power has become the yin and yang for researchers in this field.

The traditional explanation for how acupuncture heals is based on the idea that a person's life energy—Qi—runs along certain lines, or meridians, through the body. Disease is believed to result from disruption in this flow. Qi is said to reach the upper level of the skin at more than 350 specific points, and these points are where a ther-



DAVID PERRY Getty Images

apist can influence the streams of energy, restore balance and heal.

One of the problems of trying to pin down the science of acupuncture is that the term can describe a wide variety of therapeutic approaches that diverged in each country that adopted the Chinese healing art. French, Japanese and Korean acupuncture versions exist, for example, and these variations do not completely agree on which Qi points to use for each illness. Many techniques are also used to stimulate these points: heat, pressure—even lasers. But the most famous, and for that reason the best studied, is the use of metal needles to penetrate the skin, followed by electrical or manual stimulation. Another issue is that no one has been able to discover anatomical or physical structures that correspond to Qi or to the meridians along which the energy runs.

Although the existence of Qi remains unproved, plenty of evidence confirms that needles can affect biology. The best studied of these effects are those that influence pain, starting with groundbreaking studies on pain relief by Ji-Sheng Han of Peking University's Neuroscience Research Center. In the 1970s and 1980s his group demonstrated that the body can release natural, or endogenous, painkillers called endorphins in response to the needles. Han performed electronic acupuncture on rats and then infused their blood into a control group that had never been treated. After treatment, the animals in both groups were less sensitive to pain, apparently because the endogenous painkillers were transferred along with the blood.

### Pricks vs. Pain

Many years and experiments later, acupuncture is known to operate on many levels that control pain. The stimulation of nerve fibers at the point of insertion causes the secretion of many factors known to influence pain processing. Enkephalin and dynorphin, natural opiates produced by the body, are released and inhibit the electrical arousability of the nerve cells in the spinal cord. This mechanism is how practitioners explain the direct painkilling effect of acupuncture, the so-called immediate analgesic effect. As long as the needle is in the skin, the stimulus from the needle diverts the stimulus from the pain being fought.

Experts such as physician Marcus Baecker of the department of internal and integrative medicine at the University of Duisburg-Essen in Germany believe a second mechanism accounts for



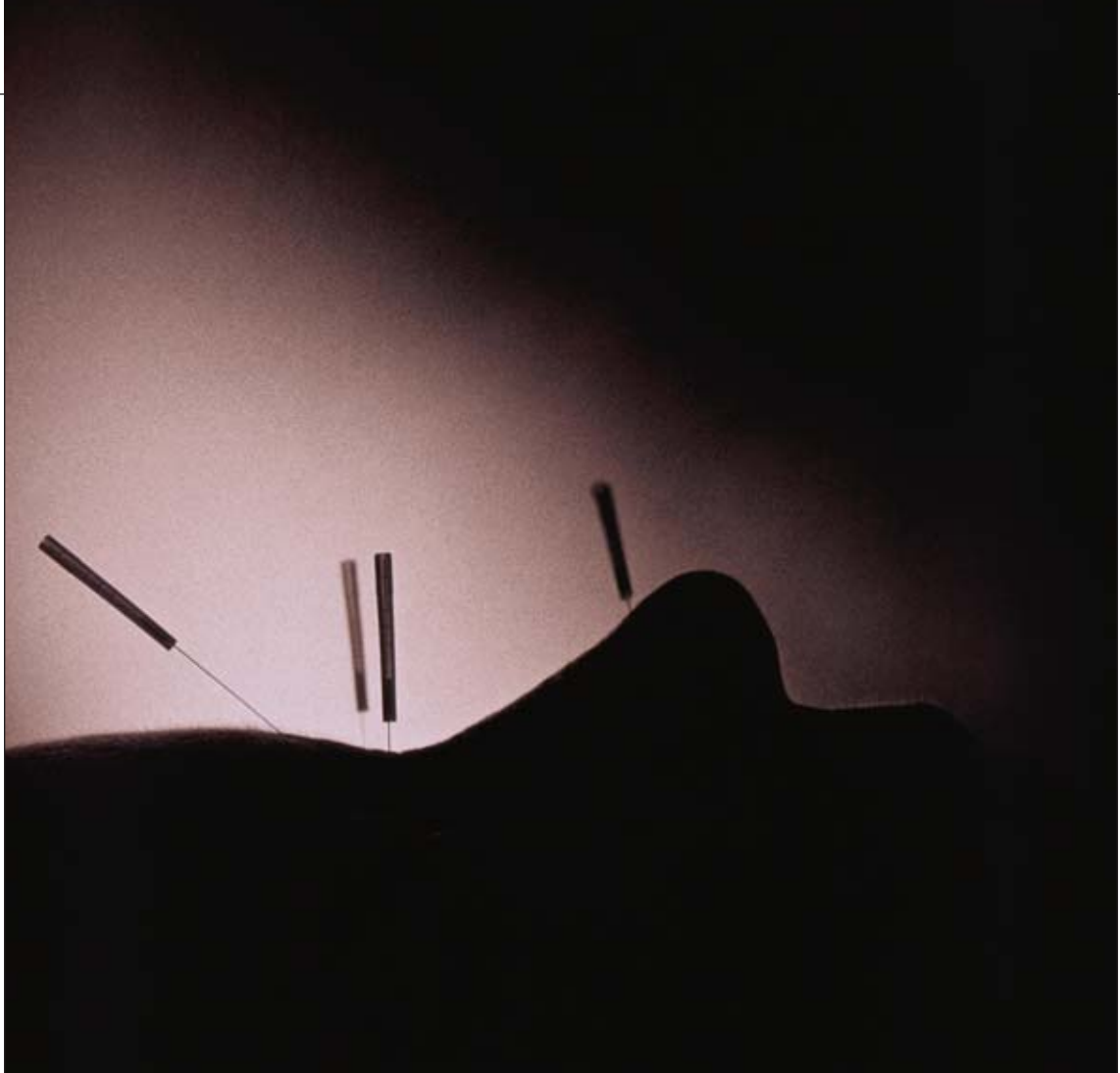
longer-lasting relief. Inhibitory synapses in an area of the spinal cord called the posterior horn can cause an enduring reduction in the conductivity of nerve fibers passing the signals upward toward the brain, so that the real pain no longer reaches the cerebrum—and, as a result, is not consciously perceived.

But acupuncture's influence also runs deep into the brain. Scientists at the China Academy for Traditional Chinese Medicine in Beijing and at Harvard Medical School published studies in 2000 and 2002 that used functional magnetic resonance imaging (fMRI), a technique that monitors neuronal activity, to see whether needles inserted in the hand changed brain function. They found decreased activity in the hippocampus, hypothalamus and other components of the limbic system, which is known to be involved in pain sensation. Changes were also recorded in the activity of the somatosensory cortex, a brain region involved in processing pain, when the researchers probed certain acupuncture points.

Acupuncture-stimulated release of hormones, neurotransmitters such as serotonin, and endorphins may explain some of the other physical ef-

### (The Author)

**SUSANNE KEMMER** is a freelance science writer in Heidelberg, Germany.



fects of this therapy, including changes in blood flow and immune cell function. That acupuncture can trigger the release of multiple factors and cause shifts in brain function lends credence to the idea that it can influence many different systems of the body. And some clinical evidence supports this idea as well.

A 1997 report sponsored by the National Institutes of Health, for example, concluded that “clear evidence” indicates that needle acupuncture is an effective treatment for a variety of conditions, including nausea after surgery and chemotherapy and vomiting caused by morning sickness during pregnancy. The report noted “reasonable evidence” for the ability of acupuncture to lessen pain from surgery and menstrual cramps. In addition, unpleasant side effects from the needles were found to be less frequent than those associated with many conventional treatments.

With all this biological evidence, it might seem that the case for acupuncture’s effectiveness is all sewn up. But whereas some patients do seem to fare better after acupuncture treatment, it is

not clear that the healing is caused by the needles themselves.

For Dominik Irnich of the department of anesthesiology at the University of Munich, some of the secret of this Chinese export lies in its psychological effects: “The patients simply get a lot more attention here. The patient and doctor are not separated by a desk—instead he both touches her with his hands and observes her carefully. In addition, there are continual conversations about problems and symptoms—that alone, as a rule, has a positive impact on the course of disease.”

### Placebo or Not Placebo

Determining how much of the effect of acupuncture is placebo has been difficult. It is clear, though, that some of the biological effects do not rely on the patient even being aware of the treatment, as demonstrated in a 2004 study by Winfried Meissner’s research team at the Friedrich-Schiller University of Jena in Germany. The researchers anesthetized 16 subjects and exposed them to what, in a conscious person, would have

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# Convincing people that a needle has gone through their skin—when it has not—is **not an easy trick.**

been painful electric shocks to the right forefinger, while treating them at acupuncture points in the leg. During the procedure, they documented subjects' reactions using a method that measures evoked potential in their brain waves. These are characteristic lines in the electroencephalogram (EEG), which are produced in response to the stimuli—and correlate with pain. Although the subjects were not conscious of the needles, their arousal potentials were reduced by the acupuncture.

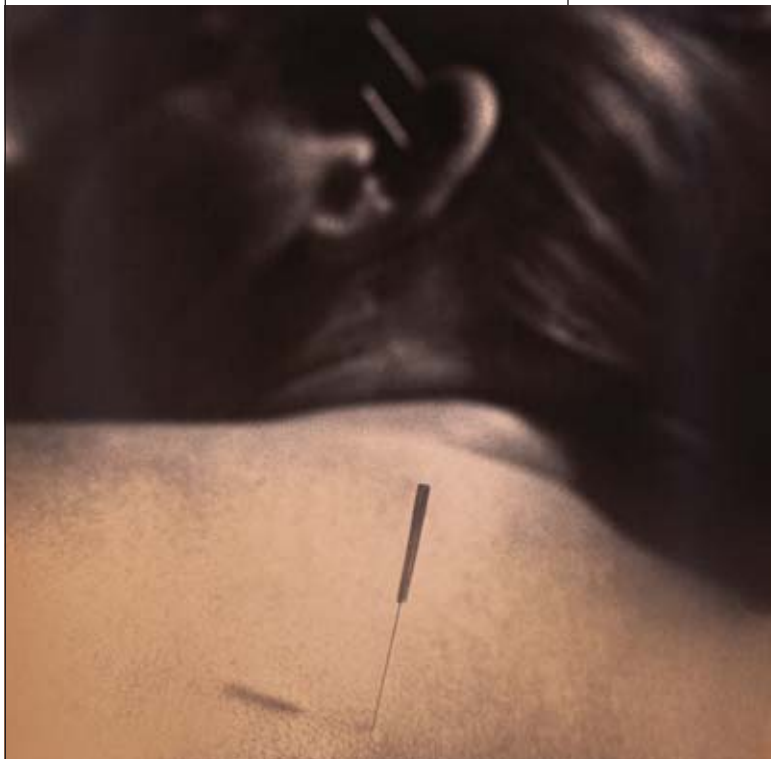
Yet the real test of whether a treatment is better than a placebo is to compare it with one in a placebo-controlled trial. For pharmaceuticals, that only requires making a sugar pill convincing enough to impersonate the drug under evaluation. Convincing someone that a needle has gone through his or her skin—when it has not—is not an easy trick, however.

## A Deceptive Needle

That challenge has not stopped researchers from trying. In 1998 Konrad Streitberger and his colleagues at the Clinic for Anesthesiology of the University of Heidelberg in Germany reported their development of a needle that barely pricked the surface but was designed to look as if it had penetrated. As a result, the subjects—although they felt the needles—did not know that the needle was inserted into only the top layer of skin. The Heidelberg group found that the subjects who received a real acupuncture treatment evaluated the procedure as considerably more successful than did the patients who received placebo acupuncture.

Other trials, however, have come to different conclusions. In 2005 Irnich and his colleagues studied 270 people with tension-type headaches who were treated with authentic acupuncture, superficial needles at nonacupuncture points or no treatment at all. They found that patients who received acupuncture recorded significantly fewer headaches than patients who received no treatment. But no difference in headache relief occurred between the placebo and real acupuncture. Other trials have found that sham acupuncture's effects lie between those of traditional acupuncture and no treatment.

Exactly how this mixed bag of results from placebo-controlled trials should be interpreted is a controversial topic. One possible explanation



is that for some conditions acupuncture may work through precise biological mechanisms triggered by the needles, whereas for others its effect may be nonspecific and driven by psychological placebo effects. It is also possible that the needles may have effects at many depths: pressure at the surface, a minimal penetration of the skin, and at full insertion. Some effects might rely on the exact placement of the needle, and some may not. If this is true, then creating a placebo control for acupuncture may be impossible.

The fact that acupuncture shows promise as a primary treatment for some conditions and as an addition to conventional therapy for others has convinced many experts that it is worth conducting larger trials to sort out some of these issues. Such research also offers scientists a rare opportunity: the chance to improve on a therapy that is already millennia old. **M**

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# No Place Like HOME

What makes a house feel like home? Psychological research offers insight into what people want and need for happy living **By Antje Flade**

**A**ustrian artist and architect Friedensreich Hundertwasser, or Peace-Kingdom Hundred-Water, as his name translates, was anything but conventional. Known for bright colors, curved lines and organic forms—as well as performances in the nude—his work often generated controversy. A low-income housing block of his design in Vienna is no exception: the Hundertwasser Haus, planned in 1977, features undulating floors, a grass- and soil-covered roof and huge trees growing inside rooms, their branches reaching out from the windows. Hundertwasser refused payment for the complex, explaining that he wished merely to “prevent something ugly from going up in its place.”

Throughout his lifetime Hundertwasser preached regularly against conformity in domestic architecture. In 1958 he famously declared his *Mould Manifesto against Rationalism in Architecture*, stating that “a person in a rented apartment must have the freedom to lean out of his window and transform the building’s exterior within arm’s reach. And he must be allowed to take a long brush and paint everything so that, from far away, everyone can see: There lives a man who distinguishes himself from his neighbors!”

FREITAG zefa/Corbis



People feel uncomfortable when they are not able to personalize their living spaces.

Hundertwasser, who died in 2000 at the age of 71, was ahead of most of his contemporaries. Only recently has the mainstream residential construction community realized that people feel uncomfortable and dissatisfied if not given the opportunity to personalize their living spaces. As the ever rising number of do-it-yourself television programs and mushrooming home improvement superstores illustrates, we feel an almost instinctual need to nest, to transform a generic house into an individual home. This realization has forced many architects to rethink their role and, like Hundertwasser, consider that the tenants of any building should be able to influence its design.

### Home, Sweet Home

What, exactly, makes a house a home? What is required for, say, an apartment to meet our needs, not just physically but emotionally? What architectural features contribute to our overall sense of happiness or well-being? It was not until the 1970s, in the wake of interest in environmental psychology, that psychologists and sociologists turned to the concept of “dwelling.” It is no simple matter. But researchers have devised various methods to gauge the livability of a place. These tools have offered interesting insights into the psychology of environments and the effects of buildings on their inhabitants.

Most people report that the happiest place in which they lived was their childhood home, to which they then compare all subsequent dwellings. In 1990 social psychologist R. Steven Schivo of Wellesley College asked children and teenagers to make sketches showing how they would change the plans of their homes if they could.

Although most reduced the size of their living rooms, they otherwise had very different ideas about what made for an ideal layout: some added bathrooms, playrooms and guest rooms; others included studies, practice rooms and libraries.

As this study and others demonstrate, it is practically impossible to list, in general terms, what makes a “good place to live.” Residential spaces are very personal—and our preferences shift over time. A child will want plenty of room to play and to learn; an older person will care about security and accessibility; a young single person might yearn for ample space to entertain.

We can, however, say something about what people tend to value the most. In 1984 psychologist Sandy Smith, then at Queensland University of Technology in Australia, asked her students to describe good and bad living accommodations. From their responses, she crystallized five criteria as being especially important: contact with neighbors, privacy, flexible usage, opportunities for personalization, and security.

### Good Neighbors

Most people would agree that a good home design allows for the right amount of interaction among neighbors. Psychologists Oddvar Skjaeveland of the University of Bergen in Norway and Tommy Gärling of Göteborg University in Sweden have evaluated which architectural features best enable positive neighborly relationships. Their work points to the importance of so-called transition zones between public and private spaces. In these areas, such as courtyards and communal gardens, neighbors can enjoy meeting spontaneously for casual conversation—even more so if there are places to sit.

Equally important, neighbors need to be able to get away from one another. Studies show that whether or not people deem a residence to be a good place to live varies directly with the amount of space, or impression of space, around it. The higher the perceived housing density, the less livable a building seems and, in truth, the more often conflicts arise with others living nearby. Accordingly, people almost universally value solid construction that reduces the noise from next door.

Similarly, a good home must offer its occupants privacy, which in this context means that they can decide at any moment if they would rather be alone. Of course, privacy needs vary with age: toddlers may not object to sharing a room, whereas adolescents will. Also, these needs vary with culture. American houses often have

#### FAST FACTS

#### Environmental Psychology

**1>>** What makes for a “good home”? Generally speaking, five criteria seem especially important: contact with neighbors, privacy, flexible usage, opportunities for personalization, and security.

**2>>** That said, people have very different ideas about what living accommodations should offer. These preferences depend on age, culture, life circumstances and previous housing experiences.

**3>>** Homes that do not offer sufficient private space or areas for socializing can have a detrimental effect on their inhabitants’ mental health.



# Most people describe their childhood home as their happiest dwelling.



Residential spaces are very personal—making it impossible to list, in general terms, what makes a “good place to live.”

large windows, exposing them to passersby, but inside children and parents have separate rooms. In Japan, however, it is the opposite: high walls or fences block off the outside world, but inside there are virtually no barriers between common and private areas.

As Smith’s study shows, people also prefer dwellings in which they are able to use space flexibly—turning, for instance, a spare bedroom into an art studio or an unused corner into an office. In this regard, single-family houses usually rate higher as “good homes” than apartments do. Having more square footage gives people more space to adapt to their lifestyle. What is undesirable in a layout is any area so small that it can serve only as a transit space, such as a hallway. In contrast, tiny balconies, gardens, courtyards or terraces enhance a home’s perceived livability, presumably because they increase the volume available for personalization.

Last, people want lodging that makes them feel safe. If burglaries or muggings are a problem in the neighborhood, then security will become of paramount importance. This observation correlates well with the “hierarchy of needs” the-

ory, created in 1943 by American psychologist Abraham Maslow. According to his scheme, which is frequently represented as a pyramid, fundamental requirements such as warmth and security must be completely satisfied before higher-level needs, such as the desire for status, can be considered.

## To Move or Not

For the housing and construction industries, home satisfaction is viewed as the most important indicator of success. Admittedly, the decision to move usually hinges on how content people are in their current living situation—not shifts in the real estate market or new housing opportunities. Builders love to advertise that their properties meet their customers’ needs, pointing to high levels of home satisfaction as proof. There are, in fact, several ways to measure this variable:

## (The Author)

**ANTJE FLADE** trained in psychology and lives in Darmstadt, Germany. Her research interests include environmental psychology, housing and mobility issues.

Designs that ignore the **wants and needs** of residents are destined to fail.

Hundertwasser Haus in Vienna, Austria, features undulating floors, a grass- and soil-covered roof and huge trees growing inside rooms.



researchers can ask direct questions or, better still, draw conclusions from residents' responses to indirect questions. (Try the questionnaire on the opposite page to gauge your own home satisfaction.)

But home satisfaction is scarcely a good yardstick for rating the quality of a house. Instead of reflecting a home's physical characteristics, it tends to expose the occupants' subjective attitudes. For example, more than 20 years ago psychologist Kevin Hourihan of University College Cork in Ireland asked residents on a street plagued by heavy traffic about their home satisfaction. He expected that they would complain about the noise and air pollution, but they barely took them into account. Moreover, residents' attitudes toward home incorporate personal feelings and planned actions. If there is no question

of moving in the near future, for instance, almost no one will admit to dissatisfaction.

Even so, in numerous surveys three characteristics prove excellent measures of home satisfaction: the size of the housing units, the proximity to neighbors, and the quality of the surrounding infrastructure—meaning services, schools, day care centers, cultural resources, playgrounds, parks and access to shops. In addition, an expensive home typically increases its owners' satisfaction level. And homeowners are, on average, more satisfied than renters.

Of interest, homeowners are not more satisfied simply because they are also typically wealthier and enjoy bigger homes. In 2003 Rosemary Hiscock of the Karolinska Institute in Sweden and her colleagues at the University of Glasgow in Scotland found that people of limited means

MAURITIUS/SUPERSTOCK

who are nonetheless able to buy housing have a greater feeling of security—they can no longer be evicted—and increased self-esteem.

Other studies have demonstrated a correlation between housing status and mental health. In 2002 psychologist Gary W. Evans and his colleagues at Cornell University evaluated the quality of various living quarters, considering not just size, age, energy consumption, and so forth but also more complex factors, such as whether the layout provided sufficient flexibility and privacy. They then asked occupants to rate their moods for three months, scoring from one to five such statements as “I was very nervous” or “I suffered from depressed moods.” The scientists concluded that a lack of privacy—just as much as lack of space for socializing—produced measurable, negative effects on the residents’ emotional well-being.

### House Happy

If you look around any large city today, most housing complexes show little originality. Planners have traditionally argued that municipal architectural standards demand a certain degree of uniformity. But ignoring the psychology of residential spaces can prove downright disastrous, as several notorious failures have shown. Perhaps most infamous was the massive Pruitt-Igoe complex, built in St. Louis during the early 1950s for low-income tenants.

The Pruitt-Igoe project called for 33 11-story buildings and a staggering 2,870 apartments. The units featured innovative paint from which graffiti might be easily cleaned. Special gratings protected the lighting and heating fixtures from damage. And “skip-stop” elevators—which opened only on certain floors—were included to lessen inconvenience and congestion. Architectural magazines praised the designers—among them Minoru Yamasaki, who would later design the World Trade Center in New York City—saying that they had not wasted any space.

But within a few years, Pruitt-Igoe lay in near ruins. Broken glass and abandoned cars littered the parks and playgrounds. Countless windows were broken, and the hallways, stairways and elevators stank of garbage and urine. Tenants did not interact, because the space-saving corridors and stairways made it impossible to stop and talk. Instead these alleylike common areas attracted criminals. Eventually more than half the apartments were empty, and as the situation worsened, the authorities decided to demolish them. To this day, the site stands unused—in part

## Home Satisfaction Quiz

Score the following questions on a scale from one, meaning “very dissatisfied” or “never,” to five, meaning “very satisfied.” Divide your total sum by six. If the resulting average falls between four and five, you are satisfied with your home.

- How satisfied are you with your home and/or neighborhood?
- Overall, how would you rate your home satisfaction?
- Would you move here again?
- Would you recommend this home to someone else?
- Would you recommend your neighborhood or town to someone else?
- Will you still be living here in two years? —A.F.

because digging up the foundation has proved prohibitively expensive for new developers.

It would be naive to think that improved urban planning could ameliorate the kind of social problems that plagued Pruitt-Igoe. So, too, architectural design can never promise total home satisfaction or sustained happiness. But nor can its influence be discredited or ignored. Our psyches are heavily swayed, in both positive and negative ways, by the spaces we move through and occupy.

As Alain de Botton writes in his new book, *The Architecture of Happiness*, “An ugly room can coagulate any loose suspicions as to the incompleteness of life, while a sun-lit one set with honey-colored limestone tiles can lend support to whatever is most hopeful within us. Belief in the significance of architecture is premised on the notion that we are, for better and for worse, different people in different places—and on the conviction that it is architecture’s task to render vivid to us who we might ideally be.” **M**

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# LOVE OF

By Walter A. Brown

# GARBAGE

**If this magazine is perched on one stack of hundreds in your home, you may suffer from an odd disorder that scientists are beginning to understand**

Look around my house, and you will find some weird stuff.

I can justify a few pieces of my collection. The small tribe of kachina dolls and the menagerie of wooden African animals, for instance, have their aesthetic merits. My interest in pharmacology has spawned a personal museum of mortars, pestles and old medicine bottles.

But then I think about other things I cannot bring myself to throw out: old squash and tennis rackets, unread magazines from the last century, and piles of T-shirts on the verge of disintegration. I also hold on to old coffeemakers. I have to admit, that just seems a bit nutty.

Lucky for me—and a lot of other people—it is not the content of a person's closets that defines what psychologists would call a “problem” with collecting. It is the amount of clutter and its consequences. Although accumulating stuff can be expensive and the objects sometimes take up a good bit of space, most people do not run into trouble. They do not spend more money than they can afford, nor do they allow the stuff to take over essential living space. But the urge to hang on to things can go awry. And when it does, the consequences of this hoarding may be severe.

Hoarders have intrigued artists, scientists—and even talk show hosts. Oprah Winfrey dedicated a show in May 2005 to hoarding, featuring a woman named Kathryn who collected 81 cats and six dogs—along with a second woman, Krista, who crammed her four-bedroom house

with mounds of clothes and junk. Although hoarders have long been subjects of fascination, it is only recently that researchers and clinicians have begun to warn that an unhealthy compulsion to stockpile may afflict more than a million people in the U.S. alone. And now a handful of neurologists, psychiatrists and psychologists

have started to identify the underpinnings of the condition and have come up with a promising treatment.

People afflicted with this problem acquire and are unable to discard large numbers of items. According to Randy O. Frost, a psychologist at Smith College, what distinguishes the illness from normal collecting is the extent to which the

hoarder's stuff takes over his or her living space and the impairment that is produced by the relentless collecting.

The most commonly saved items include newspapers, old clothing, bags, books, mail, notes and lists. These items can accumulate to the extent that space is no longer available for essential activities such as cooking, sleeping and bathing. Frost points out that the harmful consequences range from failure to pay bills (they get lost in the clutter) to injury and even death when a pile of refuse topples over. The most clinically severe end of the hoarding continuum is dubbed the Diogenes syndrome, after the Greek philosopher who lived in a barrel. In this syndrome, severe self-neglect and a refusal to accept help accompany hoarding, resulting in nutritional deficiency and other health problems.



**Room in house of Langley and Homer Collyer, brothers who were found dead in 1947 in their New York City brownstone on Fifth Avenue, buried amid more than 100 tons of junk.**

BETTMANN CORBIS



To collect is human: almost everyone has keepsakes or souvenirs. The size or content of a collection does not necessarily spell trouble, unless it starts to interfere with living space or to represent a health hazard.

### Collecting Data

Hoarding is explicitly mentioned in the “bible” of psychiatry, the American Psychiatric Association’s Diagnostic and Statistical Manual (DSM-IV), as a symptom of obsessive-compulsive personality disorder (OCD). It is seen also in a raft of other conditions, including traumatic brain injury, tic disorders such as Tourette’s syndrome, mental retardation and neurodegenerative disorders. But some experts have started to argue that hoarding should be considered a syndrome or entity in its own right. To begin with, hoarding can crop up in the absence of any other pathology and result in severe impairment. Some evidence also indicates that hoarding is more common than is generally recognized.

Frost and his associates surveyed public health departments and found that over a five-year period they received only 26 complaints of hoarding per 100,000 people. He believes this figure seriously underestimates the prevalence of the problem. He points out that the condition in which hoarding appears most frequently is OCD and that it afflicts 20 to 30 percent of those patients. Given that OCD occurs in about 1 to 2 percent of the world population, this would put the prevalence of OCD-related hoarding at about four per 1,000.

In addition, a study by Jen-Ping Hwang and his colleagues in the department of psychiatry at Taipei Veterans General Hospital found that 22.6 percent of hospitalized patients with de-

mentia engaged in clinically significant hoarding, and Dan J. Stein in the department of psychiatry at the University of Stellenbosch in Cape Town, South Africa, found that patients in a geriatric psychiatry inpatient unit displayed a hoarding prevalence of 5 percent. Stephen Salloway, director of neurology and the Memory and Aging Program at Butler Hospital in Providence, R.I., estimates that about 5 percent of the dementia patients he sees exhibit clinically significant hoarding. Based on the extent of the disorder found in such sample populations, Sanjaya Saxena of the University of California, San Diego, estimates that there are one million to two million hoarders in the U.S. alone. He considers hoarding a major public health problem.

One misconception about the condition is that it must arise from highly aberrant psychological processes or brain activity. In fact, similar behavior is common and highly conserved across a wide variety of species. In humans, clinically significant, compulsive gathering that results in impossible clutter appears to be on a continuum with “normal” collecting and the universal tendency to hold on to clothes, books and other items far beyond the point that they are used or needed. In some situations, excessive storing may even be useful. For example, in times of war or in other situations when supplies of food, medicine and other crucial supplies might be limited, people accumulate goods.

Similarly, much of what is called hoarding in animals is adaptive and has a clear purpose. Animal research has focused on food hoarding, but birds and other animals also collect aluminum foil, beads and other brightly colored objects, sometimes as a part of mating behavior. Some hoarding behavior in animals, however, does not seem to be purposeful and is more like the pathological kind seen in humans—collecting as an end in itself. Normal rats are known to stockpile food seemingly for the sake of it, without regard to how much they already have, and given the choice, hamsters prefer keeping additional glass beads to food.

Animal studies have also revealed a complex set of controls on this behavior. Chemical mimics of the neurotransmitter dopamine stimulate food hoarding in rats, whereas analogues of another neurotransmitter, serotonin, reduce it. Sex hormones and opiates also modulate this activity. Genetic research points to the importance of brain chemistry as well. Patients who hoard are more likely than a typical person to have close relatives with similar symptoms. Genetic analy-

### (The Author)

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BOB THOMAS Getty Images

# (Not all the clutter has to be removed, just enough to reduce fire and health hazards.)

sis of hoarders with OCD and Tourette's syndrome has linked this compulsion to a specific form, or allele, of *COMT*—a gene that encodes an enzyme involved in the metabolism of dopamine and other neurotransmitters.

Electrical stimulation and lesion experiments in animals suggest that the drive to amass items comes from the brain's subcortical limbic system, made up of evolutionarily primitive structures that are involved in survival-related behaviors such as appetite, sexuality, aggression and emotional behavior. The onset of hoarding in patients with traumatic brain injury, stroke and neurodegenerative diseases has also helped pinpoint brain regions involved in this behavior. Saxena and his colleagues used brain imaging to study OCD patients with compulsive hoarding and showed they had lower metabolic activity in their limbic system.

Steven Anderson and his colleagues at the University of Iowa recently found that 13 out of 86 patients with brain lesions developed persistent hoarding behavior. In this case, though, all 13 had damage to the mesial prefrontal region, a part of the frontal cortex responsible for so-called executive, high-order cognitive functions. Salloway points out that patients with frontotemporal dementia, whose brains are damaged in the same region, are especially prone to hoarding. He suspects, as does Anderson, that the compulsion can arise when high-level circuits that normally inhibit this behavior are interrupted.

## Healing Hoarding

Ultimately, a thorough understanding of the neural basis for hoarding could lead to better treatment. Any such advance would be welcome because the disorder has been notoriously difficult to treat. Both clinical trials and case reports show that compulsive collecting does not respond well to either the antidepressants or the psychotherapies that alleviate other OCD symptoms. Recently, however, Frost and his colleagues have developed a cognitive-behavioral treatment that addresses hoarding's various psychological motivations.

Some hoarders have difficulty discarding things because of their indecisiveness; others because of their emotional attachment to their possessions. As Frost points out, hoarders believe that their possessions are part of them: "They can't distinguish important from unimportant things."

Whereas most people see a 10-year-old news magazine as trash, hoarders believe it holds critical information. Still others do not discard items because they suffer executive dysfunction and other cognitive deficits that make it difficult to organize their belongings and to distinguish between items they need and those they do not.

Frost's technique uses group therapy sessions to help patients identify the thoughts and emotions that sustain their behavior and then challenges the validity of these motivators. Patients are also encouraged to practice new patterns of behavior. They go on shopping excursions without buying anything, discard objects both in the group setting and as homework, and they learn methods for organizing their belongings. Preliminary results are promising. Patients treated in this manner begin to tolerate the anxiety associated with discarding objects and gradually reduce the extraneous junk filling up their homes. Not all the clutter has to be removed, just enough to reduce fire and health hazards.

Frost says that anyone working with these patients must remain mindful of the excruciating anxiety they go through at the mere thought—let alone act—of throwing out one of their things. A key principle is that the hoarder is the only one who should discard possessions. Attempts, however well meant, by family members or other caregivers to tidy up by tossing stuff out will alienate the patient and increase his or her isolation and resistance to any kind of intervention. Without some change on the hoarder's part, as soon as relatives, therapists or camera crews leave, the newspapers, mail, and assorted odds and ends will invariably pile up once again. **M**

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# A Pill to Fix Your Ills?

Valium and other benzodiazepine drugs work quickly to ease anxiety. But are they always the best solution?

BY HAL ARKOWITZ AND SCOTT O. LILIENFELD

*Mother needs something today  
to calm her down  
And though she's not really ill  
There's a little yellow pill  
She goes running for the shelter  
of a mother's little helper*

AS THESE LINES of the 1966 Rolling Stones song “Mother’s Little Helper” remind us, Valium and other members of the benzodiazepine class of tranquilizing drugs have long been a part of popular culture. But how well do these medications work, and what are their dangers?

At some point in their lives, 25 percent of Americans will develop an anxiety disorder: panic disorder, generalized anxiety disorder, phobias, obsessive-compulsive disorder, or post-traumatic stress disorder. Many other people will experience significant problems with anxiety and stress that are not severe enough to qualify for a formal diagnosis. It is therefore not surprising that psychiatrists and psychologists have sought effective treatments for anxiety. Psychologists have looked primarily to psychotherapy and psychiatrists primarily to drug therapy.

The main type of psychotherapy that has been shown to be helpful in the treatment of anxiety problems is cognitive-behavioral therapy (CBT). This therapy involves gradual exposure to feared situations and the implementation of cognitive methods

to reduce the catastrophic thinking that is so common in anxiety. This therapy typically yields positive effects in approximately 16 sessions. When the anxiety problem is severe, however, or when other significant psycho-

helpful for anxiety. They typically require two to four weeks before they start to work and need to be taken daily. In contrast, benzodiazepines work soon after the patient swallows the pill—in most cases leading to relaxed feelings within 10 to 30 minutes. Benzodiazepines can be taken on either a regular or an as-needed basis. Given how they act, it is not surprising that they are among the most commonly prescribed medicines for anxiety [see table on opposite page].

Despite this understandable appeal, numerous concerns and controversies surround the use of benzodiazepines. Further, many people are unaware of many of the potential problems with these drugs.

## Side Effects and Withdrawal

In general, benzodiazepines all have the same calming effects, but they differ in the strength of these effects (which also depends on dosage) and how long they stay in the system. Most people who take benzodiazepines experience

few side effects if they take them for short periods or on an as-needed basis. Yet because anxiety disorders are usually chronic, benzodiazepine treatment is often prolonged, resulting in an increased risk of side effects.

Side effects that can occur primarily with regular and extended use include physical and psychological dependence,



logical problems are present, therapy may take considerably longer.

Two main types of drugs are used to treat anxiety: selective serotonin reuptake inhibitors (SSRIs) and benzodiazepines. SSRIs, which include Prozac, Zoloft and Lexapro, constitute the most common drug therapy for depression, and they also have proved

COURTESY OF HAL ARKOWITZ (top); COURTESY OF SCOTT O. LILIENFELD (bottom); ADAM HART-DAVIS SPL/Photo Researchers, Inc. (Valium)



Side effects that can occur primarily with regular and **extended use** include physical and psychological dependence.

withdrawal symptoms (especially when the medication is discontinued abruptly), reduced alertness, drowsiness, physical fatigue, impaired physical coordination, and memory loss. When benzodiazepines are ingested along with alcohol, the likelihood and strength of these side effects increase greatly, because both are central nervous system depressants. In rare cases, the results can be fatal.

One of the most common withdrawal symptoms is rebound anxiety—return of the anxiety at the same or worse levels than before. Studies have shown that 50 to 75 percent of people with panic disorder relapse when they stop taking benzodiazepines. Other possible withdrawal symptoms include abdominal pains and cramps, depression, dizziness, lethargy (physical and mental inertness), flulike symptoms, palpitations, insomnia and irritability. People who experience withdrawal often return to the medication to avoid these symptoms, which can result in a vicious cycle of dependence.

**New Options**

Benzodiazepines and newer related medications that aid sleep—for example, Ambien and Lunesta—are also commonly prescribed for people with insomnia, which is often associated with anxiety disorders. Although both sets of medications can cause dependence, this problem is less serious for the newer sleeping medications. A recent study of a new nonbenzodiazepine sleeping medication called Rozerem raises the possibility that it may not have potential for substance abuse or for motor or cognitive impairment, although psychological dependence is still a possibility.

Research studies show that a viable alternative to anxiety or sleeping medications of any kind is CBT, which

has proved quite helpful for patients. CBT and the benzodiazepines are about equally effective for anxiety when subjects are compared before and after treatment. After discontinuation of treatment, however, those who relied on a benzodiazepine experience much higher relapse rates. Generally, if patients keep taking the drug, they will relapse at a lower rate, but

**COMMONLY PRESCRIBED BENZODIAZEPINES FOR ANXIETY**

COMMON BRAND NAME	GENERIC NAME
Xanax	Alprazolam
Klonopin	Clonazepam
Valium	Diazepam
Ativan	Lorazepam

then they risk the side effects of regular and long-term use. In contrast, no such problems exist with CBT. Moreover, drug therapy is considerably more expensive than CBT because the medications must be taken continuously for their effects to persist. In contrast, the effects of CBT endure fairly well after treatment has ended.

Is combining CBT and antianxiety medication better than using either alone? Studies find that combined treatments (when the drug is either a benzodiazepine or SSRI) do not do any better than either treatment alone and find that subjects administered medication show significantly higher relapse rates when it is discontinued.

So, what's the bad and good news? First, the bad news. Benzodiazepines work only as long as you continue to take them. They can cause psychological and physiological dependence, lead to serious withdrawal symptoms and engender a number of other undesirable consequences.

Now the good news. Used on an as-needed or short-term basis, benzodiazepines can alleviate anxiety problems while minimizing side effects. Used regularly, they are effective in reducing anxiety problems but cause side effects. Tapering off the drug, rather than stopping abruptly, can minimize problems with withdrawal.

Anyone seeking treatment for an anxiety problem would do well to first consider CBT. This treatment is more effective and cheaper than drug therapy and does not cause dependence, withdrawal or other side effects.

A second option to explore before taking benzodiazepines are SSRIs, which have fewer problems with dependence and withdrawal. As a third option, benzodiazepines may be helpful when their use is closely monitored by a knowledgeable psychiatrist or other medical professional. **M**

HAL ARKOWITZ and SCOTT O. LILIENFELD share an interest in helping the general public to distinguish myth from reality in the field of mental health. Arkowitz is a psychology professor at the University of Arizona, and Lilienfeld is a psychology professor at Emory University. They welcome reader suggestions for column topics: editors@sciammind.com

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## Eeny, Meeny, Brainy Mo

### Why Choose This Book? How We Make Decisions

by Read Montague. Dutton, 2006 (\$24.95)

Your brain is a highly efficient choosing machine, a biological computer designed by evolution to make the best possible choices using the least possible resources.

If you doubt it, just touch the top of your head. The fact that it is only warm and not hot, like the processor in your desktop computer, is testament to your brain's efficiency. And that we are alive at all is evidence that the choices our brains make are pretty good ones. Baylor College of Medicine neuroscientist Read Montague shows how this need for efficient choice has shaped the way our brains work.

Brains—and the organisms they guide—have to make choices that maximize the chances of survival in a harsh environment. And they have to do it

with only a fraction of the energy from whatever food the organism can scrounge up that day.

Montague spends most of the book detailing the clever ways the brain has discovered to make efficient choices, including computing slowly and imprecisely to save energy. Our brains not only need to compute the best available choice (fight or run, hunt or hide); they also need to assign a value to each of those choices—and to the very computations themselves—to avoid wasting energy on computations that would not enhance our likelihood of survival.

He also shows how the reward/pleasure system of the brain, mediated by the neurotransmitter dopamine, is used to critique our mental models of reality. When things go as expected, our background dopamine levels, along with our model of reality, stay the same. Rewards that are bigger or

### Why Choose This Book?



smaller than expected result in more or less dopamine being released and also cause the current model to be revised.

What about our sense of self? It is a simulation, a model we make of ourselves, useful for calculating what “we” should do in a given situation.

But Montague is not reductionist. He thinks that we are more than just the sum of these computations. He says that it is our ability to question our brains' automatic valuations that gives us true agency, a true self. Without that ability, we would be mere automatons.

On the broader points, Montague does not always convince—for instance, is the “self” that overrides the brain's valuations merely the result of other valuations? Nevertheless, he has written a fascinating book that answers many interesting questions and raises even more. —Kurt Kleiner

# Mind Reads

## The Downside of Positive Thinking

### Never Saw It Coming: Cultural Challenges to Envisioning the Worst

by Karen A. Cerulo. University of Chicago Press, 2006 (\$73)

NASA and the FBI, Karen A. Cerulo believes, were looking at the world through rose-colored glasses. Cerulo, a sociologist at Rutgers University, says it is human nature to look on the sunny side of life and that culture reinforces our optimism. We catalogue the strongest athletes, the most beautiful people, the greatest bargain, but don't work to identify the abysmal. As a result, she believes we have a blind spot for worst-case scenarios. She says this explains why even experts often pay little attention to warnings of impending disaster, whether it is the explosion of the *Challenger* space shuttle or the terror attacks of 9/11.

She coins a name for our lopsided view of reality: “positive asymmetry”—we emphasize the best and overlook the worst. She points out that a single “best” hotel chain emerges in *Consumer Reports* surveys, whereas less popular brands are lumped



at the bottom without a “worst.” And books for expecting parents spend far more space on naming baby than on the possibility of stillbirths or birth defects.

Not every facet of American life is dominated by positive asymmetry, Cerulo admits, and she highlights two fields as counterexamples: medicine and computers. Your doctor doesn't admire your rosy cheeks—she is looking for high blood pressure. And most computer technicians are hired to look for software bugs and expect crashes. Cerulo gives these professionally pessimistic outlooks credit for avoiding two potential crises: the SARS outbreak in Asia that might have become an epidemic; and the Y2K problem, which might have disabled computers at the turn of the millennium.

Ideally, Cerulo maintains, we should strive for balance, keeping the best *and* worst clearly in sight. If we heed her advice, it is hard to avoid the weakest link in Cerulo's argument: in some cases, there is no purpose in pursuing the worst. Who is eager to know the worst baseball pitcher, the ugliest person or the nastiest hotel? And will readers buy magazines that aim to review as many bad books as good ones? —Jonathan Beard

## A Lab of Her Own

### Why Aren't More Women in Science? Top Researchers Debate the Evidence

edited by Stephen J. Ceci and Wendy M. Williams. American Psychological Association, 2006 (\$59.95)

Two years ago then Harvard University president Lawrence Summers set off a firestorm of controversy when he remarked that innate differences between women and men may explain why fewer women succeed at the highest levels of science and math. But the debate following his speech has been “overwhelmingly underinformed by scientific evidence,” lament Cornell University psychologists Stephen J. Ceci and Wendy M. Williams. “The time for moving beyond slogans and rallying cries seems overdue.”

What solid scientific evidence do we have that could explain why the gender divide at high-end scientific professions is still gaping wide? “Is the lack of women in these fields a consequence of less ability—or simply

less interest? Are there innate differences in some kinds of ability that explain the unsettling statistics, or is culture to blame?” To answer those questions, Ceci and Williams asked top researchers in the field to analyze the topic solely on the basis of “robust, empirical evidence.”

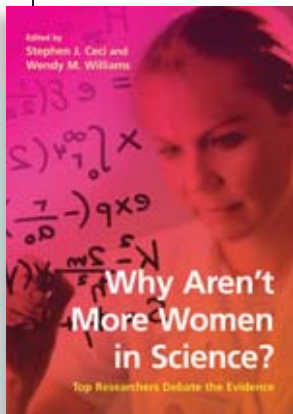
The resulting 15 essays present a diverse range of views. The essayists analyze scientific evidence on the topic ranging from biologically based gender differences to a variety of social factors. Besides the often discussed aspects, such as gender stereotypes that result in discrimination or the incompatibility of motherhood and high-powered careers, we also learn about lesser-known factors.

Stanford University psychologist Carol Dweck, for example, presents evidence that highly intelligent girls often do not cope as well with setbacks as their male peers. Melissa Hines, a psychologist at City University London, argues that the notion of innate gender differences, even if incorrect, could be a self-fulfilling prophecy because expectation and beliefs influence brain and behavior.

The essays show that the issue is too complex to be explained with just one answer. Complicating the problem is the fact that the different essayists interpret similar data in different ways. For example, Doreen Kimura of Simon Fraser University in British Columbia translates average sex differences in math and science test performances into strong evidence that innate talent differences do exist between boys and girls and are partially to blame for the underrepresentation of women in science and math. Virginia Valian of Hunter College, City University of New York, however, considers sex differences in test performances insignificant because they are minute compared with cross-national differences. Females from some countries outperform American males.

Although the book leaves readers well prepared to participate in a debate on the topic, it does not provide an answer to the question it poses. Ceci and Williams conclude: “We challenge you to decide for yourselves: Why aren't more women in science?”

—Nicole Branam



## Suffer the Little Children

### The Boy Who Was Raised as a Dog

by Bruce D. Perry and Maia Szalavitz. Basic Books, 2007 (\$26)

For many of the children described in this compelling book, bad things come in twos. The first blow for each child is a traumatic event—the death of a loved one, sexual assault, or an early environment deprived of love and stimulation.

The next wave of insults consists of botched attempts to heal them. Blood-spattered children who witnessed the murder of their parents are left to recover on their own. The suspected victims of a satanic cult are forced to confess by having knuckles driven painfully into their ribs, part of a bizarre treatment known as “holding therapy.”

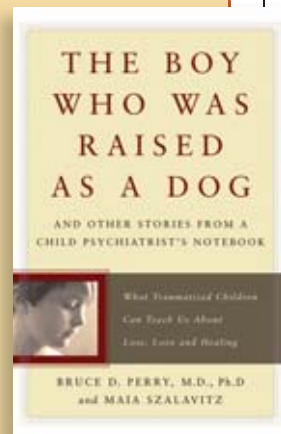
When psychiatrist Bruce D. Perry first entered this world of damaged children, he did not have anything better to offer them. But he soon started to see connections between the broken minds of these youngsters and what he and other neuroscientists were learning about the ways stress could wreak havoc on the developing brains of laboratory animals. With his co-author, journalist Maia Szalavitz, Perry tells the story of how his team used these insights to develop new treatments and founded the Child Trauma Academy in Houston ([www.childtrauma.org](http://www.childtrauma.org)) to further that research.

Physiological effects of childhood trauma, Perry found, could be severe. The boy referred to in the book's title, who for most of his six years was locked in a cage, had a brain so damaged that doctors had diagnosed him as having a birth defect. His “brain looked like that of someone with advanced Alzheimer's disease; his head circumference was so small that he was below the second percentile for children his age.” Studies by Perry's group and others have found similar damage in children raised without affection or stimulation.

Perry's highly effective therapy starts by understanding at what point in brain development the child experienced neglect or abuse. Then he tailors treatment to safely stimulate the affected brain areas. Once those regions show a positive response, therapists move on to the second brain region harmed and so on, an approach dubbed “neurosequential.” Children who were never held or rocked as infants, for example, may get massage and music therapy.

These tools may seem modest, given some of the abuse and neglect these children have suffered. And Perry admits that the technique does not always work. Unfortunately, some experiences missed during brain development can never really be fully repaired. As he says of one mother and daughter who were never able to form loving attachments as infants, they “still bear scars from their early childhoods.... Like people who learn a foreign language late in life, Virginia and Laura will never speak the language of love without an accent.”

—Phil Cohen



# asktheBrains

Anesthetics work by blocking transmission of nerve signals to pain centers in the central nervous system.

## How does anesthesia work?



**William J. Perkins**, associate professor of anesthesiology at the Mayo Clinic College of Medicine in Rochester, Minn., offers this explanation:

offers this explanation:

**ANESTHETICS WORK** by blocking transmission of nerve signals to pain centers in the central nervous system. The exact mechanisms for general anesthetics are not completely understood.

In 1846 physician Oliver Wendell Holmes, Sr., coined the term “anaesthesia” for drug-induced inability to experience sensation (particularly pain) after the first publicized demonstration of inhaled ether rendered a patient unresponsive during a surgical procedure. Today two broad classes of such agents, called local and general, can induce anesthesia.

## Targeted Pain Relief

Local anesthetics, such as novocaine, bind to and inhibit the function of the sodium channel in the nerve cell membrane. The channel allows passage of charged molecules called sodium ions from outside to inside the nerve cell, which is required for the propagation of nerve impulses that ultimately send messages about pain to the brain. Novocaine’s action obstructs the movement of nerve impulses from tissue innervated by, or containing, nerves at the site of a local-anesthetic injection but causes no changes in awareness and sense perception elsewhere in the body.

In contrast, general anesthetics provide overall insensibility to pain. The patient loses awareness, yet his vital physiological processes, such as breathing, continue to function. The most commonly used such agents are inhaled, and their chemical structure is related to ether. Globally speaking, they primarily act on areas of the cen-

tral nervous system. Unlike local anesthetics, general anesthetics reduce nerve transmission at the synapses, the sites at which chemical messengers called neurotransmitters are released by neurons, causing the adjacent nerve cells to respond. General anesthetics interfere with the response of receptors and ion channels to neurotransmitters, thereby decreasing nerve cell activity and transmission.

## Sites of Action

General anesthetics bind only very weakly to their sites of action and functionally interact with cellular proteins in a lipid environment (which is not water-soluble). Both factors make it difficult for scientists to determine their exact binding structure.

Because the general anesthetics bind only weakly, high concentrations, often more than 1,000 times greater than those for typical receptor- or protein-targeting drugs, are needed to achieve an anesthetic state. This fact results in anesthetic binding to, or interaction with, cell membranes and large numbers of proteins in a nonspecific manner. It also affects the function of many proteins in nerve cell membranes, making it challenging to ascertain which of them are the key mediators of anesthetic action. The second problem, that protein-signaling interaction is in a lipid environment, makes it harder to gain detailed structural information for membrane proteins than it is for water-soluble proteins. Such structural data are essential for understanding how anesthetics exert their effects on membrane proteins. These proteins do not easily crystallize, which is a requirement for the current molecular structure “gold standard,” x-ray crystallography.

Because of the lack of structural data, it remains unclear whether anesthetics exert their primary effects by

direct interaction with these proteins or by indirect interaction with the lipids surrounding them. Despite such limitations, researchers are taking advantage of methods to better discern how anesthetics work at the molecular level.

Genetic tools, for example, enable investigators to alter specific functions of a protein and then determine whether this protein can be linked to sensitivity or resistance to anesthetic action in less complex organisms. Other approaches, including sophisticated structural modeling of anesthetic binding to protein targets, also show promise. The protein targets for different agents do not appear to be the same, so probably no single molecular mechanism of action exists for all anesthetics.

Thus, the simple answer to the question of how anesthesia works is that although we know a great deal about the physiological effects and macroscopic sites of action, we do not yet know the molecular mechanisms of action for general anesthetics. Many of the tools necessary to probe these mechanisms are now available, and in coming years we can look forward to new insights into how this great boon to humanity works at the molecular level. **M**

*Have a question? Send it to editors@sciammind.com*

COURTESY OF WILLIAM J. PERKINS

# Head Games

Match wits with the Mensa puzzler  
BY ABBIE F. SALNY

**1** Arrange the same eight letters to complete the blanks in the sentence below.

The ancient plate was \_\_\_\_\_ in two places, but the marks were so regular it was impossible to determine if they were accidental or \_\_\_\_\_.

**2** Rearrange the following letters into a two-word phrase meaning “a free offer to see if you like the periodical.”

**N T O R I I T L A S S B U P R C I**

**3** It was the day of the big furniture sale. “Oh,” said Pat, “this chair was \$350. Then it was reduced by 20 percent, then by \$80 and then by 80 percent. It should be free!” But what was the price?

**4** Edit the following sentence to create a common saying.

It is impossible to create a money container constructed of materials spun by silkworms using a portion of porcine animal anatomy as your basis.

**5** Fill in the missing letters to complete the word below.

**I \_ \_ I \_ I \_ I \_ Y**

**6** Begin with the number of sisters in the group of colleges called by that number, add the number of witches in *Macbeth*, multiply by the number of feet in a fathom, then divide by two. What do you have?

**7** Unscramble the letters in the grid to make an eight-word phrase offering bad advice. Move one space at a time in any direction and use each letter only once. One letter is not used, and there is one contraction. (Hint: begin with the letter in the middle of the first column.)

T	F	X	P	U	E
A	F	I	D	G	V
I	S	R	E	E	I
T	O	O	N	U	C
Y	U	D	T	S	C

**8** The two lines below start with the definition of a word. Add an “r” in front of the first word to make a new word that matches the second definition.

**A “top-notch specialist” becomes “a contest.”**  
**A “storage place for hops” becomes “to cook or overheat.”**

**9** Each letter in this sentence has been replaced by a number. Work out the code and find the quotation.

**“4-19-2 18-8 2-12-6-9 15-18-13-22 26-15-4-26-2-8 25-6-8-2, 4-26-7-8-12-13?”**

**10** Find another word that can be made from all the letters in “lampshade.”

*Abbie F. Salny, Ed.D., was the supervisory psychologist for American Mensa (www.us.mensa.org/sciamm) and Mensa International (www.mensa.org) for more than 25 years. She is the author and co-author of many challenging puzzle books, including the Mensa Think-Smart Book and the Mensa 365 Brain Puzzlers Page-A-Day Calendar (Workman Publishing).*

## Answers

1. Indented, intended.
2. Trial subscription.
3. \$40. (\$350 - 20% = \$280 - 80% = \$40.)
4. “You can’t make a silk purse out of a sow’s ear.”
5. Invisibility.
6. 30. (7 sisters + 3 witches = 10 × 6 feet in a fathom = 60 ÷ 2 = 30.)
7. “If at first you don’t succeed, give up.”
8. Ace, race; oast, roast.
9. “Why is your line always busy, Watson?” (Alphabet numbered backward, A = 26, B = 25, and so on.)
10. Headlamps. (Good for you if you found another!)

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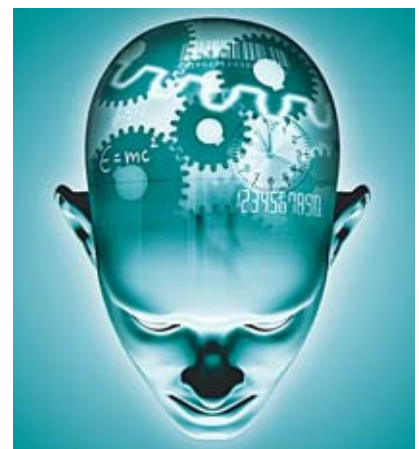
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