DEPRESSION AND ITS EVOLUTIONARY ROOTS *page 56*

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What They Do to You

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Fall *in* Love and Stay That Way

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COVER PHOTOGRAPHY BY AARON GOODMAN

Look of Love

Is there anything more powerful in human society than a steady gaze? I once, for instance, completely flustered and enraged a careless driver who nearly ran over my then toddler and stroller-riding infant daughters and me as she rolled into a gas station simply by calmly staring at her. I didn't say a word or make a gesture. "What are you looking at?!" she yelled. It's no wonder, actually: humans are so visually oriented and so social as a species, it would be surprising if we did not respond to the looks of others.

Peering into each other's eyes, then, naturally has a strong influence on that most social of activities: creating a personal, shared bond as we fall in love with another. As psychologist and contributing editor Robert Epstein writes in the cover story, "How Science Can Help You Fall in Love," the relationship-cementing effect of mutual gazing is well documented by researchers. Epstein relates some fascinating examples of his experiences with study subjects and others in his thought-provoking article. Who says science isn't sexy? Turn to page 26 for more.

Once you find your bliss, how do you maintain that passion over the decades? That is the subject of the feature "The Happy Couple," by wellness consultant and writer Suzann Pileggi. As a person who recently celebrated 20 years of marriage myself, I was curious to find out how I've apparently stumbled on the ingredients necessary for this achievement. As Pileggi shows, it is not enough to be there for your partner when he or she suffers bad news or a health crisis. It's even more critical to be warm and supportive when your loved one gets good news. If it happens frequently enough, a seemingly neutral "That's nice, honey" to your main squeeze's good news can squelch romantic fires, crippling rapport over the long term. In my case, my husband also has taught me, without saying anything specifically, how to think as part of a couple, rather than an individual, by always acting in ways that work best for both of us. Flip to page 34 to find more secrets of success for couples.

Mariette DiChristina
Acting Editor in Chief
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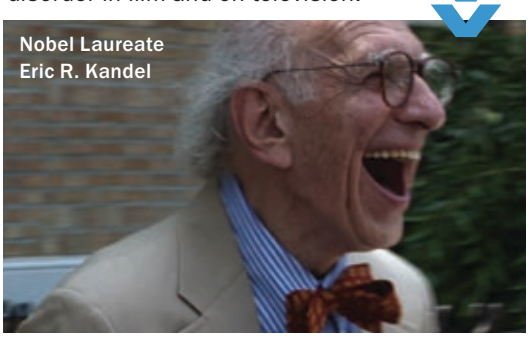
Volume 20, Number 7, January/February 2010

FEATURES

SPECIAL SECTION LOVE

COVER STORY

DEPARTMENTS


Nobel Laureate Eric R. Kandel

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SOCIAL EXHAUSTION

In "The Social Cure," Jolanda Jetten, Catherine Haslam, S. Alexander Haslam and Nyla R. Branscombe state: "Membership in lots of groups—at home, work, the gym—makes us healthier and more resilient." But we are not all the same. For extroverts that formula makes sense, but for introverts it does not. Unlike extroverts, who are energized by social mingling, introverts typically find the experience at the least uncomfortable and, more often than not, downright exhausting.

"Chrystal Ocean"
adapted from a comment at
www.ScientificAmerican.com/Mind-and-Brain

COGNITION IN THE WOMB

As a published freelance researcher specializing in prematurity, I must point out that Christof Koch in "When Does Consciousness Arise?" [Consciousness Redux] really short-changes the fetus. Learning, memory and language begin in utero. Psychologically, the fetus starts learning with the occurrence of the first reflexes. Reflexes are the road to exploration and discovery—predominantly about the self—and to learning new behaviors. The first type of learning to emerge is habituation, when the fetus shows a decreasing response to a stimulus each time it appears. A few babies show habituation as early as 23 weeks of gestation, and by 29 weeks all healthy fetuses can do it. Habituation shows that memory and cognition are developing.

In one recent example, a Dutch team led by Jan Nijhuis established that fetuses as young as 30 weeks' gestational age responded with a startle to a specific stimulus, in this case, a "vibroacoustic stimulation." After repeated stimuli, the fetuses stopped responding, meaning the stimulus had become a "safe" one—that is, the fetuses habituated. That study is one of many that offer evidence for fetal learning and memory. [For more on this study, see "Recall in Utero," by Karen Springen, on page 15 of Head Lines.]

Paula M. S. Ingalls
Bernard, Maine

PAIN AND HORMONES

As a physical therapist, I found "I Do Not Feel Your Pain," by Ingrid Wickelgren, extremely interesting, but I question the part of the article that discusses female hormone levels and the effect they have on pain perception. I find that women (myself included) have more pain toward the end of their menstrual cycle when estrogen is lower, not when estrogen is higher as the article suggests. I have also experienced more pain while taking birth-control pills. Perhaps there is another chemical phenomenon at work.

"pt_char"
adapted from a comment at
www.ScientificAmerican.com/Mind-and-Brain

KNOW MUCH ANTHROPOLOGY?

Wray Herbert's article "Don't Know Much Biology" [We're Only Human] exaggerates the human problem with learning biology because he relies on studies of modern urban Americans who have essentially no interaction with nature. All of us anthropologists who study traditional rural cultures are struck by the incredible knowledge of biology that even very young children have. They not only recognize hundreds of species of plants and animals, but

they also know which varieties are related to which others, what is alive and what is not, and so on—the very things that the American students in the studies Herbert cites do not know. Recent studies of this effect in traditional cultures by anthropologist Norbert Ross of Vanderbilt University and psychologist Douglas Medin of Northwestern University confirm it rigorously.

This point would not be worth making if it did not relate to another article in the same issue, "A New Vision for Teaching Science," by J. Randy McGinnis and Deborah Roberts-Harris. They tell of "new" discoveries in science teaching—but what they recommend is exactly what traditional people do! They teach their kids through actual practice, starting with a limited range of activities and expanding outward. Kids are apprentices and doers, not mere memorizers of stray facts for multiple-choice tests. As a result, they actually learn. They have to; a Maya child (most of us who look at this seem to study the Maya) who was as ignorant of his or her environment as an urban kid in the U.S. would not last long.

E. N. Anderson
Professor Emeritus of Anthropology
University of California, Riverside

HAPPY YOUNG, HAPPY OLD

"Say Cheese," by Jordan Lite [Head Lines], discusses a study in which the brightness of kids' smiles in their childhood photographs was found to predict their future marriage success. A cheerful, spontaneous smile is a good prognosticator of a cheerful personality—this is a proverbial no-brainer. And most people find it is a real pain to be around unhappy people or even someone who seems unhappy.

How much money was paid for this "study" to determine the obvious?

"Lowndes"
adapted from a comment at
www.ScientificAmerican.com/Mind-and-Brain

MORE ON NIGHT OWLS

In "Early Risers Crash Faster" [Head Lines], Siri Carpenter explains a study in which so-called night owls got a boost in energy 10 hours after waking up that the early risers did not experience. But the article did not discuss each group's duration of sleep. Was there a difference in the number of hours slept between the early risers and the night owls? In addition, did the researchers measure in the lab or otherwise take into account each group's quality of sleep?

"jh443"
adapted from a comment at
www.ScientificAmerican.com/Mind-and-Brain

CARPENTER RESPONDS: *The researchers chose subjects who all had equivalently healthy sleep, and the study was designed to let the sleepers follow their natural, preferred sleep schedule. On the nights before the cognitive tests, each subject's bedtime and wake time—and therefore total duration of sleep—were individually tailored to their previously stated sleep preferences (which were verified by biometric surveillance for several nights prior to their night in the sleep lab). Most subjects appear to have slept around eight hours. The complexity of this study design, in my opinion, contributes to the study's rigor.*

ERRATA "Calendar" [July/August 2009] incorrectly stated that Herbert Jasper made the first electrical tracing of the human brain in 1934. The first electroencephalogram (EEG) recording was in fact made by German physician Hans Berger of the University of Jena in 1924. Berger published his findings in 1929 and coined the terminology for EEG as well as for alpha and beta waves.

"A Patchwork Mind," by Melinda Wenner [July/August 2009], incorrectly stated that almost all children with Prader-Willi syndrome suffer from psychotic disorders. Although psychosis affects most people whose Prader-Willi syndrome arises from having an extra chromosome from one parent, these people constitute a minority of cases. A 2008 survey by the Prader-Willi Society of America polled 279 parents of children with the syndrome and found that about 7 percent of the children had been diagnosed with psychosis.

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Partake of intellectual adventure in the company of experts and fellow citizens of science. Join Scientific American Travel on a cruise down the mighty St. Lawrence Seaway into the heart of contemporary cosmology, genetics, and astronautics. Black holes, parallel universes, and the Big Bang itself are among the abstract ports of call Dr. Max Tegmark shows us. You'll have a new perspective on the significance of food choices after indulging in a discussion with Dr. Paul Rozin. Satisfy your curiosity about navigating space, from the science behind solar sails to mapping the Interplanetary Superhighway, with Dr. Kathleen Howell. Maneuver through the newly charted territory of the human genome, genetic medicine, genetic agriculture, and all their nuances and consequences with Dr. David Sadava. Set the scene for Summer on the Bright Horizons 7 conference on Holland America Line's m.s. Maasdam, sailing Montreal to Boston May 29–June 5, 2010.

ASTROPHYSICS & COSMOLOGY

Speaker: Max Tegmark, Ph.D.

The Mysterious Dark Side of Cosmology

A recent avalanche of accurate measurements has revolutionized our understanding of cosmology, but also stumped us with new puzzles. What are the dark matter and dark energy that together make up 96% of the stuff in our universe? Learn about some of the most promising candidates and some of the experiments that may solve these mysteries.

How Did It All Begin — Or Did It? How Will It All End?

Humans have asked the big questions for as long as we've walked the Earth. We've made spectacular progress on answers in recent years, and have discarded much of what cosmology textbooks told us until quite recently. Get the latest on competing ideas about the origin of the universe, their implications and how they can be experimentally tested.

I've Got Questions: Black Holes Edition

Join Dr. Max Tegmark and get the scoop on what we know about black holes and what remains mysterious. Plus, using a fully general-relativistic flight simulator take a scenic orbit of the monster black hole at the center of our Galaxy.

Parallel Universes

Is physical reality larger than the part that we can observe? Dr. Tegmark argues that not only are parallel universes likely to exist, but that there may be as many as four different levels of them.

A Brief History of Our Universe

With our cosmic flight simulator, we'll take a scenic journey through space and time. After exploring our local galactic neighborhood, we'll travel back 13.7 billion years to explore the Big Bang itself and how state-of-the-art measurements are transforming our understanding of our cosmic origin and ultimate fate.

Cosmology and the Meaning of Life

When skygazing on a clear night, it's natural to wonder if we have company in the observable universe. Join Dr. Tegmark for a a status report on the search for extrasolar planets and extraterrestrial life. We'll discuss and speculate about possible long-term futures for life on earth and in the cosmos.

SCIENTIFIC AMERICAN TRAVEL

ASTRODYNAMICS

Speaker: Kathleen Howell, Ph.D.

Mission Design: Exploring the Solar System

Scientific mysteries and huge surprises await solar-system space explorers. Dr. Howell lays out the principles and process of designing a space mission. Get the scoop on the successful engineering techniques and the challenges in getting humans and robots to space destinations.

Astrodynamics: Natural Orbits from Epicycles to Chaos

From the dawn of time the paths of the planets, moons, and other natural bodies have fascinated humans. Join Dr. Howell and take a look at the key areas of orbital mechanics. You'll have a sharper perspective on space exploration, and will be well equipped to follow important open questions in astrodynamics.

Solar Sailing

400 years ago, Johannes Kepler observed tha comet tails are sometimes blown about by a "solar breeze". Taking that cue, scientists have designed solar sails that transfer the momentum of light energy to their spacecraft—pushing it without using fuel. Today scientists are building test sails, analyzing solar sail capabilities, and planning solar sail missions. Learn the facts with Dr. Howell.

Riding the Interplanetary Superhighway

The gravity fields of the Sun, planets, and solar system bodies interact creating the interplanetary superhighway. Picture a vast network of "tubes" that indicate low-energy trajectories throughout the solar system. If you'd like to swing on a celestial body, tune in as Dr. Howell covers the practical applications of libration points, and the use of the interplanetary superhighway in spacecraft missions.

GENETICS: THE DNA OF LIFE

Speaker: David Sadava, Ph.D.

The Personal Genome

If the 20th century was the "century of physics", the 21st is the "century of biology", particularly genetics. This century opened with the deciphering of the human genome. Join Dr. Sadava and you'll learn what a genome is, and what we know about it. Discover insights into where we may have come from, both as human groups and in relation to the other creatures with whom we share the Earth.

Can Knowledge of Genomes Transform Agriculture?

Many people are concerned with what they eat. Fewer people worry about the human food supply. Genetics and DNA have a lot to say about both of these topics. With Dr. Sadava as your guide, get the latest on the "green revolution", the interaction of the human genome with foods, and the potential and risks of genetically altered crops.

Cloning and Stem Cells

The first plant was cloned in the mid-1950s and the first animal several decades later. In this lecture, you will learn how and why these feats were accomplished. Human cloning is now a possibility and the promise of using stem cells to treat diseases and even improve athletic performance in healthy people is something we'll also discuss.

Genetic Medicine: Can Knowledge of the Genome Transform Medicine?

Your health is determined by both heredity and environment. Progress has led to the near-elimination of many infectious diseases and treatments for other diseases. Dr. Sadava will show you that through studies of the genome, we can describe what goes wrong in the many diseases that have a genetic component, such as cancer and heart disease. Get a researcher's input on how these descriptions may lead to cures and personalized treatments.

THE PSYCHOLOGY OF FOOD

Speaker: Paul Rozin, Ph.D.

Obesity and Unhealthy Food Choices in Cultural Perspective: The French-American Contrast

Americans worry about their weight and eat low fat food, and French eat a higher fat diet than Americans and worry less. Doesn't that make you wonder why obesity is much lower in France than in the USA? Settle into a sedentary session with Dr. Rozin and we'll compare how French and Americans adapted to major changes in the food world and get the scoop on how the French have managed to be less afflicted by obesity and more engaged in the enjoyment of eating.

Psychological, Cultural, and Biological Perspectives on Some Foods

Why do billions of people in the world add hot chili pepper, which irritates their mouth, on most of their foods? Would you drink pure water recycled directly from sewage water? How do you feel about T-bone steaks? Why is chocolate irresistible? Dr. Rozin will shed light on the biological and cultural history of these substances.

The Emotion of Disgust

How did a basic food rejection mechanism designed to protect the body from toxins and disease culturally evolve to become a reaction to all sorts of offenses like incest, murder, and cheating? Get a behind-the-scenes look at disgust, and the factors that shape it. Join Dr. Rozin for an exploration of the meanings of disgust, and the wide-ranging implications of the fundamental processes behind it.

Hunter-Gatherer Thinking in The 21st Century

Humankind's adaptations to our ancestral environment have equipped us with feelings and mental shortcuts which often aid us in the modern world. However, sometimes they are maladaptive in our rapidly evolving world. Explore the methods humans use to determine what to eat and what to avoid, and how humans deal with the many potential risks that the modern world presents.

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THE GRAND FINALE:

Private tour of the MIT campus and luncheon/tour at the MIT Museum

(June 5, 11am–3pm)

Max Tegmark, Ph.D. Associate Professor of Physics at The Kavli Institute for Astrophysics & Space Research at MIT, along with some of his MIT associates, will direct our private "insiders" tour of the MIT campus and research facilities.

After our campus tour we'll break for lunch in the MIT Museum. We'll then continue with our private tour—inside the museum. "MIT Museum, founded in 1971, is the museum of the Massachusetts Institute of Technology, located in Cambridge, Massachusetts. It hosts collections of holography, artificial intelligence, robotics and history of MIT. Its holography collection of 1800 pieces is the largest in the world, though not all of it is exhibited." [from Wikipedia] (This tour is optional and costs $95 per person. Lunch and a one-way transfer from pier to MIT are included.) ▼

MIT campus

IKON IMAGES/CORBIS

>> POLICY

Bringing Science into the Clinic

An accreditation program could help bring better treatments to patients

The high cost of health care is no secret. Revamping clinical psychology could be one way to make the system more efficient—while also helping psychologists better serve their patients, according to a recent report from the Association for Psychological Science. The report details an accreditation system that has been in development for two years, which will certify training programs that focus on scientifically validated treatments and instruct their students in the scientific method. The system would also create a "seal of approval" to show prospective patients that a psychologist received such an education, the report says.

"Many of the people being trained today aren't trained to understand and apply science to patients out in the real world, so patients aren't getting the treatments most likely to help them," says Timothy Baker, a psychology researcher and professor of medicine at the University of Wisconsin–Madison and co-author of the report. Clinical psychology continues to depend on outdated, ineffective strategies of diagnosis and treatment—and surveys show individual practitioners often value their own experience or a "hunch" over scientific evidence, ultimately hindering their ability to effectively help patients. "We're simply not taking advantage of what is known in scientific research," Baker says.

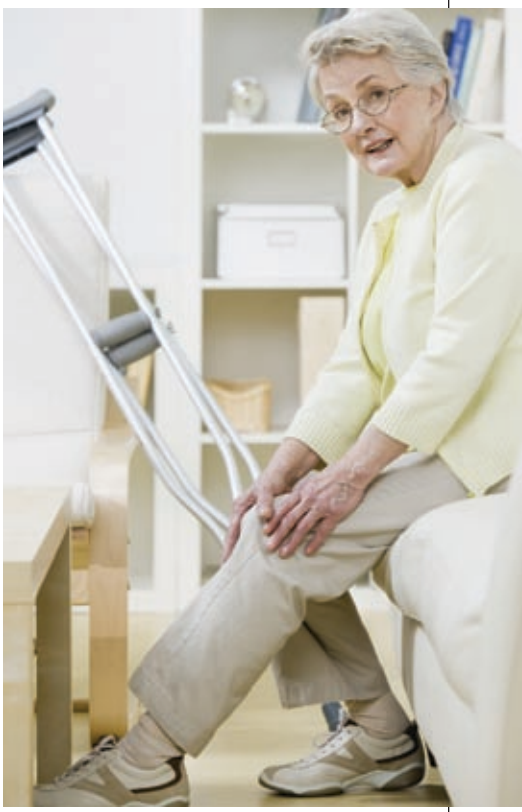
With a stronger scientific background, psychologists not only will be able to better choose treatments for patients and gauge therapy's effectiveness, but they also could become "more sophisticated users of psychological research," Baker notes. "They'll contribute to research and improve treatments."

—Allison Bond

>> DISEASE

Inflamed Neurons

The body's immune response may speed up memory loss in Alzheimer's



Inflammation in the body has gotten a bad rap recently, thanks to the exacerbating role it may play in health problems such as heart disease and cancer. Now there may be one more malady to add to the list: Alzheimer's disease.

When inflammation arises in the body as a result of infection or injury, the immune response also appears to accelerate memory loss in people with Alzheimer's, according to a recent study published in the journal *Neurology*. In this study of changes in patients' cognitive abilities over a span of six months, Alzheimer's patients who had chronic (ongoing) inflammation as a result of, for instance, obesity or arthritis experienced four times the amount of memory loss as compared with patients without such inflammation. And those with chronic inflammation who also experienced an acute immune response (short-term, such as from an infection) were even worse off: their memory loss accelerated 10 times faster than patients without any inflammation.

"When we started the study, we thought short-lived events would be important," says lead author Clive Holmes, a professor of biological psychiatry at the University of Southampton in England. "We hadn't realized how important chronic inflammation was going to be."

So how does inflammation, whether from an infection or from chronic disease, damage the brain? The answer lies in the body's immune response, which launches an attack on invading pathogens, releasing inflaming proteins such as tumor necrosis factor, or TNF. This molecule causes the vagus nerve, which extends from the brain to the abdomen and controls vital functions such as heartbeat, to send an electrical impulse to the brain, thereby directing the brain to secrete its own immune messengers.

In people with healthy brains, this chain of events merely leads us to feel under the weather for a few days. But cells in the brains of Alzheimer's patients may be in a constant state of low-level inflammation. Therefore, if they are exposed to a pathogenic threat or chronic disease, they can leap into full-fledged inflammation, releasing compounds that ultimately kill brain cells. Scientists aren't quite sure why cells end up dying, but some neurons may be annihilated in an effort to stop the virus's spread, whereas others could be destroyed by accident in the quest to rid the body of invaders, Holmes says.

The study's results could help physicians minimize Alzheimer's memory loss by cutting chronic inflammation, such as by helping their patients lose excess weight. Or researchers could try to aim right at the source: "If inflammation in the body is causing [inflammation] in the brain and if you can dampen that signal, blocking TNF could play a role in slowing Alzheimer's disease," Holmes states. —*Allison Bond*

AGE FOTOSTOCK

>> CHILD DEVELOPMENT

To Spank or Not to Spank

A task force concludes that parents probably should not use spanking as a punishment

PETER DAZELEY Getty Images (spanking); 3D CLINIC/GETTY IMAGES (neurons)

Corporal punishment has long been a hotly debated subject, with conflicting study results and opposing ideologies feeding the fire. Now the results of a five-year effort to review the scientific literature are in: a task force appointed by the family services division of the American Psychological Association (APA) concludes that "parents and caregivers should reduce and potentially eliminate their use of any physical punishment as a disciplinary measure."

Psychologist Sandra A. Graham-Bermann of the University of Michigan at Ann Arbor, who chairs the task force, announced the recommendation in August at the APA's annual meeting. In a presentation, she explained that the group of 15 experts in child development and psychology found correlations between physical punishment and an increase in childhood anxiety and depression, an increase in behavioral problems, including aggression, and impaired cognitive development—even when the child's prepunishment behavior and development were taken into consideration.

The task force was not unanimous in its conclusion. Psychologist Robert E. Larzelere of Oklahoma State University argued that the research is flawed and that the evidence against spanking is "faulty." In the few studies that have compared spanking with other forms of punishment, such as restriction of privileges, grounding and time-outs, all the punitive measures examined resulted in similarly negative outcomes in children, Larzelere said. He recommended that parents use spanking as a backup when gentler forms of punishment are not working. "Premature bans against spanking may undermine loving parental authority," Larzelere said.

Most members of the task force disagree with Larzelere, however, and stand firm in their recommendation against corporal punishment, which is still used by more than 90 percent of American parents at some point and condoned by more than 70 percent of the population, according to 1995 and 2005 survey data.

Long-time physical-punishment researcher Murray A. Straus, a sociologist at the University of New Hampshire who served as a consultant to the APA task force, pointed out that although the evidence against spanking is in the form of correlations (not direct causal proof), the association is more robust and stronger than the correlations that have served as bases for other public health interventions, such as secondhand smoke's relation to cancer, exposure to lead and IQ scores in children, and exposure to asbestos and laryngeal cancer. "I am confident we will eventually arrive at the same place for corporal punishment," Straus said.

The APA is reviewing the majority and minority positions of the task force and will issue its official recommendation at a later date. —*Karen Schrock*

>> NEUROSCIENCE

Electric Surprise

Stimulating brain cells may be trickier than we thought

Scientists and doctors have long used electricity to both study and treat the brain. But a report in the August 27, 2009, issue of *Neuron* indicates that the brain's response to electricity is exceptionally complex. Using a new type of optical imaging, Harvard Medical School researchers observed neurons as they were stimulated by an electrode. Instead of activating a small sphere of surrounding neurons as expected, the electrodes caused sparse strings of neurons to fire across the brain. The finding suggests that brain surgeons and the designers of neural prosthetics have a much smaller margin of error than previously thought—shifting an electrode even slightly could activate an entirely different set of neurons. —*Melinda Wenner*

>> ANATOMY

Wired for Categorization

Our innate brain structure reflects how we classify the world around us

Picture a living thing—say, a dog. Now imagine a hammer. You just activated two different areas of your visual cortex, the brain region that processes eyesight. Thinking of a dog activates an area that deals with animate objects, whereas a hammer excites one that processes inanimate things. Now a new study shows something surprising: the same thing would have happened even if you had never seen a dog or a hammer before.

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Psychologist Alfonso Caramazza of Harvard University and his team found that the visual cortex's organization around these categories of knowledge is similar in sighted people and in individuals who were born blind. The finding challenges the long-held notion that the two separate processing areas exist solely as the result of learning to recognize the differences in the visual appearance between living and nonliving things, says cognitive neuroscientist Marius Peelen of Princeton University, who was not involved in the study.

Instead something else must be driving the visual cortex's organization as well. That something could be connections to other brain areas, Caramazza suggests. From the visual cortex, information about living and nonliving objects is shuttled to different areas of the brain so as to trigger appropriate reactions. Animals, for example, could be dangerous, "but you don't have to run away from a hammer," he says. The new findings suggest that the wiring system that connects different areas of the visual cortex with appropriate regions in the rest of the brain is innate—it does not have to form gradually based on visual inputs. That means "the organization of the brain has to be understood in terms of our evolutionary history," Caramazza notes. Our brain's structure is such that we can distinguish prey and aggressors from other kinds of objects, and we have retained this structure even as we get "milk from bottles and meat from the butcher shop." —*Nicole Branan*

PSYCHOLOGY

Mixed Impressions

Researchers are developing a new understanding of how we judge people

We've all heard that people favor their own kind and discriminate against outgroups—but that's a simplistic view of prejudice, says Amy Cuddy, a professor at Harvard Business School who studies how we judge others. In recent years she and psychologists Susan Fiske of Princeton University and Peter Glick of Lawrence University have developed a powerful new model. All over the world, it turns out, people judge others on two main qualities: warmth (whether they are friendly and well intentioned) and competence (whether they have the ability to deliver on those intentions). A growing number of psychological researchers are turning their focus to this rubric, refining it and looking for ways in which we can put this new understanding of first impressions to use.

When we meet a person, we immediately and often unconsciously assess him or her for both warmth and competence. Whereas we obviously admire and help people who are both warm and competent and feel and act contemptuously toward the cold and incompetent, we respond ambivalently toward the other blends. People who are judged as competent but cold—including those in stereotyped groups such as Jews, Asians and the wealthy—provoke envy and a desire to harm, as violence against these groups has often shown. And people usually seen as warm but incompetent, such as mothers and the elderly, elicit pity and benign neglect.

New research is revealing that these split-second judgments are often wrong, however, because they rely on crude stereotypes and other mental shortcuts. Last year psychologist Nicolas Kervyn and his colleagues published studies showing how we jump to conclusions about people's competence based on their warmth, and vice versa. When the researchers showed participants facts about two groups of people, one warm and one cold, the participants tended to assume that the warm group was less competent than the cold group; likewise, if participants knew one group to be competent and the other not, they asked questions whose answers confirmed their hunch that the first group was cold and the second warm. The upshot: "Your gain on one [trait] can be your loss on the other," says Kervyn, now a postdoctoral researcher at Princeton.

AGE FOTOSTOCK

This "compensation effect," which occurs when we compare people rather than evaluating each one separately, runs counter to the well-known halo effect, in which someone scoring high on one quality gets higher ratings on other traits. But both effects are among several mistakes people often make in inferring warmth and competence. We see high-status individuals as competent even if their status was an accident of birth. And when we judge warmth, rivalry plays a role: "If someone is competing with you, you assume they're a bad person," Cuddy says.

The good news is that if you belong to a stereotyped group or otherwise know how people see you, you can try changing your image. A competent politician who strikes the public as cold, for example, can draw on his warmth reserves to better connect with voters. After all, Cuddy points out, "Everybody comes across as warm or competent in some area of their lives."

—Marina Krakovsky

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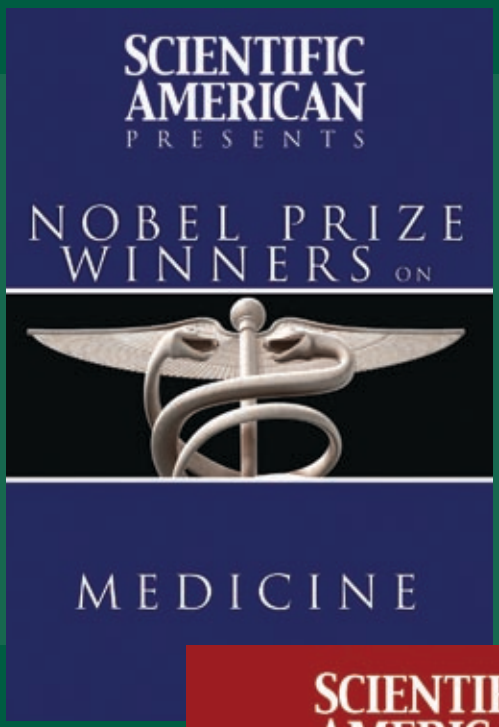

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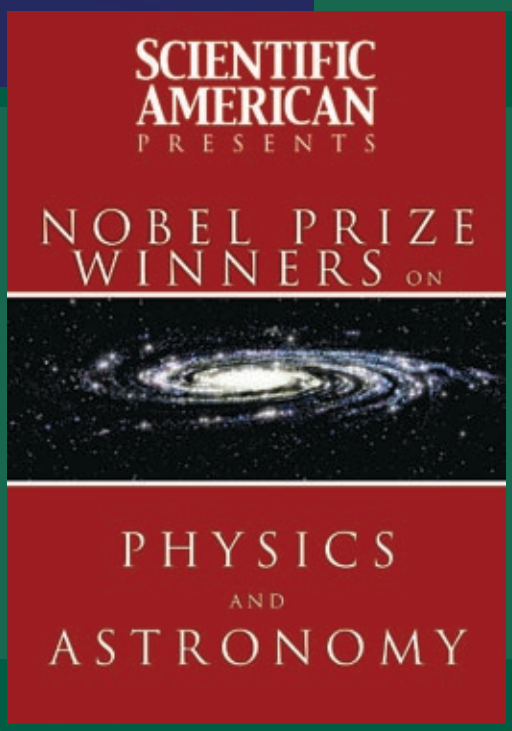

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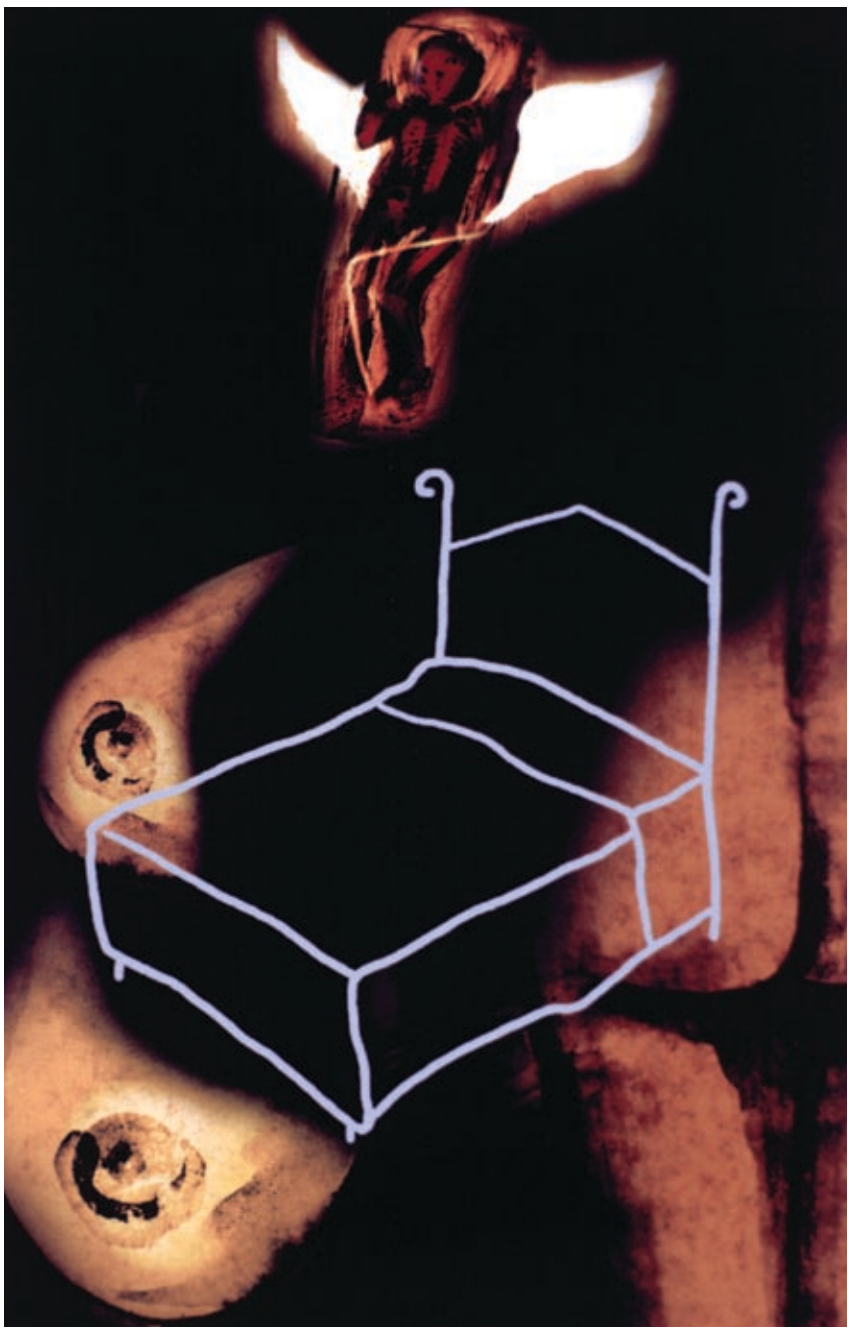
>> SLEEP

More Than Just a Bad Dream

Nightmares may fuel anxiety rather than serving as an emotional release

You awake with a pounding heart and clammy hands. Relax, you think to yourself—it was just a bad dream. But are nightmares truly benign? Psychologists aren't so sure. Although some continue to believe nightmares reduce psychological tensions by letting the brain act out its fears, recent research suggests that nocturnal torments are more likely to increase anxiety in waking life.



In one study Australian researchers asked 624 high school students about their lives and nightmares during the past year and assessed their stress levels. It is well known that stressful experiences cause nightmares, but if nightmares serve to diffuse that tension, troubled sleepers should have an easier time coping with emotional ordeals. The study, published in the journal *Dreaming*, did not bear out that hypothesis: not only did nightmares not stave off anxiety, but people who reported being distressed about their dreams were even more likely to suffer from general anxiety than those who experienced an upsetting event such as the divorce of their parents.

It is possible, however, that something is going wrong in the brains of individuals who experience a lot of anxiety, so that normal emotional processing during dreaming fails, says Tore Nielsen, director of the Dream and Nightmare Laboratory at Sacred Heart Hospital in Montreal.

But Nielsen's most recent results, published in the *Journal of Sleep Research* last June, actually bolster the Australian findings. To tease out how REM sleep—during which most dreaming takes place—affects our emotions, the Canadian researchers showed disturbing images (such as gory scenes or a women being forced into a van at knifepoint) to a group of healthy volunteers just before they went to bed. When the subjects viewed the same pictures in the morning, those who had been deprived of dream-filled REM sleep were less emotionally affected than those deprived of other sleep phases. The same was true for those who experienced fewer negative emotions in their dreams. In other words, having nightmares did not make dreamers more resilient in waking life—just the opposite.

What is not clear from these studies is whether nightmares play a causal role in anxiety or are merely an expression of an underlying problem. Most researchers agree that having an occasional nightmare is normal and not problematic. But if the dreams give rise to persistent anxiety and concern, something more serious could be going on—and it may be a good idea to talk to a mental health professional about it.

—Frederik Joelving

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>> LEARNING

Recall in Utero

Fetuses demonstrate a primitive form of memory

When does memory begin? We can't consciously call up images from our infancy, but we surely learn important, lasting associations at very early ages. New work suggests this type of memory begins even in the womb.

In a study published in July in *Child Development,* researchers from the Netherlands reported short-term memory in 30- to 38-week-old fetuses. First they put a vibrating, honking device on the abdomens of 93 pregnant women. The fetuses quickly "habituated"—that is, they figured out that the noise was not dangerous. When they heard it again 10 minutes later, they did not squirm and their heart rates did not escalate. "It's like getting used to a New York train station," says lead author J. G. Nijhuis, a professor of obstetrics at Maastricht University in the Netherlands. "It is a learning capability to distinguish safe from unsafe stimuli. It is a primitive form of memory."

The 34-week-old fetuses even recalled the sound four weeks later. "What this study clearly says is at least beginning at 30 weeks and possibly before that, the fetal brain is starting to lay down short-term memories and might even be laying down some long-term memories," says Rahil Briggs, director of Healthy Steps at Montefiore Medical Center and assistant professor of pediatrics at Albert Einstein College of Medicine. "This is a sensitive period of development."

Fetuses habituate in other ways, too. Substance-abusing moms give birth to drug-addicted babies. A study found that the babies of mothers who watch a popular Spanish-language soap opera while pregnant calm down when they hear the show's theme music. And anecdotally, some dads

who read to fetuses in the womb think their babies are born recognizing their voices, says pediatrician Tanya Remer Altmann, a spokesperson for the American Academy of Pediatrics.

The bottom line: be conscientious around the baby-to-be. "The environment in utero, and extra utero, is very important," says pediatrician Dimitri Christakis, director of the Center for Child Health, Behavior and Development at Seattle Children's Hospital. After all, the brain triples in size in the first two years of life. And perhaps even younger fetuses develop memories—researchers will investigate that possibility next. *—Karen Springen*

>> LANGUAGE

Bilingual Brains

People who speak two languages process certain words faster than others

The ability to speak a second language isn't the only thing that distinguishes bilingual people from their monolingual counterparts—their brains work differently, too. Research has shown, for instance, that children who know two languages more easily solve problems that involve misleading cues. A new study published in *Psychological Science* reveals that knowledge of a second language—even one learned in adolescence—affects how people read in their native tongue. The findings suggest that after learning a second language, people never look at words the same way again.

Eva Van Assche, a bilingual psychologist at the University of Ghent in Belgium, and her colleagues recruited 45 native Dutch-speaking students from their university who had learned English at age 14 or 15. The researchers asked the participants to read a collection of Dutch sentences, some of which included cognates—words that look similar and have equivalent meanings in both languages (such as "sport," which means the same thing in both Dutch and English). They also read other sentences containing only noncognate words in Dutch.

Van Assche and her colleagues recorded the participants' eye movements as they read. They found that the subjects spent, on average, eight fewer milliseconds gazing at cognate words than control words, which suggests that their brains processed the dual-language words more quickly than words found only in their native language.

"The most important implication of the study is that even when a person is reading in his or her native language, there is an influence of knowledge of the nondominant second language," Van Assche notes. "Becoming a bilingual changes one of people's most automatic skills." She plans to investigate next whether people who are bilingual also process auditory language information differently. "Many questions remain," she says. *—Melinda Wenner*

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>> MEMORY

Eye Giveaway

Where we look reveals memories we cannot consciously access

Do you remember how your breakfast plate was arranged this morning? Even if you don't, your hippocampus might—and growing evidence suggests that there is a way to retrieve this unconscious memory: through your eye movements.

The latest study comes from the University of California, Davis, where neuroscientist Deborah Hannula and her team showed participants photographs of faces superimposed on scenes. Later the volunteers saw the individual scenes again and had to pick the matching faces. By tracking their eye movements, Hannula and her co-workers saw that even when volunteers picked the wrong face, their eyes were drawn for a longer time to the correct one.

Previous studies yielded similar results, but the findings have been controversial because of difficulties replicating them, Hannula says. Her study also showed that the participants' hippocampus was active during the process, indicating that, contrary to conventional thinking, the brain region is involved not only in conscious memory processing but in other memory tasks as well.

The findings suggest that eye movements can be a sensitive measure for both unconscious and conscious memories, Hannula says. This fact could open up new avenues for working with cognitively impaired patients, who may not be able to verbally or otherwise report what they remember.

The results also have implications for crime scene investigations, Hannula says. For example, eyewitnesses may unconsciously remember the face of a perpetrator. Even the eye movements of the person who committed the crime could betray important information. "Imagine the perpetrator used a knife that was in the butcher block on the counter next to the refrigerator," she says. Viewing pictures of that scene would likely draw their eye movements to that butcher block.

—Nicole Branan

>> GENETICS

Jumping DNA

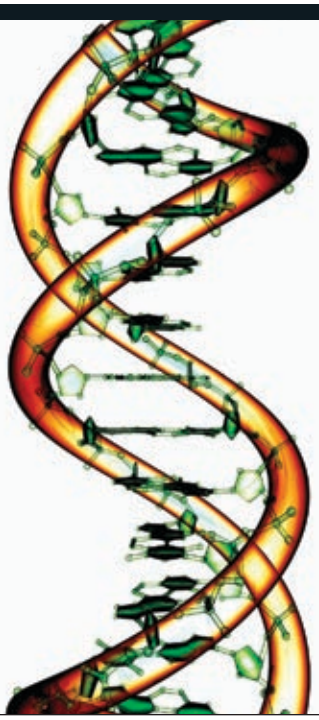
Extra mutations in neurons may help explain the brain's plasticity

In high school biology you probably learned that every one of our body's cells contains the same genome, or pattern of DNA—but it turns out that this is not true of the brain. Researchers at the Salk Institute for Biological Studies recently found that the DNA sequence in human neurons can vary not only from that of the rest of the body but even from one brain cell to the next.

The reason is "jumping genes," DNA elements that can copy and reinsert themselves in different places within the genome. These mutations increase the total amount of DNA in each neuron. Geneticist Fred H. Gage and his team at Salk looked at a type of mobile element called LINE-1. Although LINE-1s are present in all cells of the body, they appeared to be active only in developing brain cells, the researchers found.

The jumping genes generate neuronal diversity, which might help the brain adapt, Gage speculates. "Many of the things that we are going to be presented with throughout our lives are unanticipated," he says. The higher the neuronal variety in the brain, the higher the chances that it contains some cells that are capable of rising to these cognitive challenges.

—Nicole Branan



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>> MEDICINE

From Throat to Mind

The case for strep throat–induced mental illness grows stronger

Can a case of strep throat lead to a mental disorder? Some children seem to acquire behaviors associated with obsessive-compulsive disorder (OCD) after being infected with the *Streptococcus* bacterium, but for decades skeptics have claimed the connection is nothing but a coincidence. Now a new study in mice offers compelling evidence that strep can indeed affect the mind.

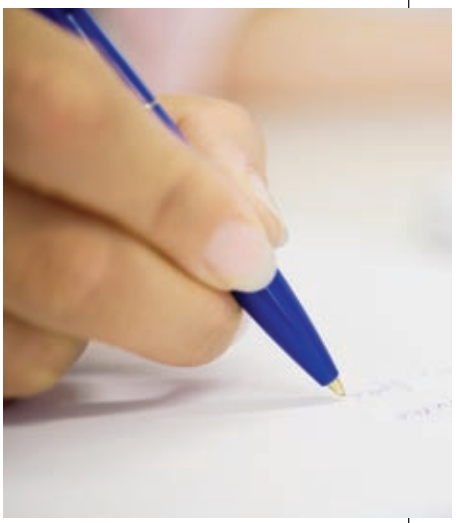
In the 1980s Susan Swedo, a pediatrician at the National Institute of Mental Health, came across several cases of children who seemed to have developed tics and behaviors resembling OCD, such as excessive hand washing, overnight. Swedo noticed that the children in all the cases had recently recovered from strep throat. The traditional strep symptoms were gone, but when she did laboratory tests, Swedo found the children's blood still contained high levels of strep antibodies. Perhaps most compelling, the symptoms seemed to abate after renewed treatment with antibiotics. Swedo became convinced that the symptoms were the result of an overactive immune response to strep bacteria. She suggested a new diagnosis called "pediatric autoimmune neuropsychiatric disorders associated with strep," or PANDAS.

Because strep throat is quite common in youngsters, many people claimed Swedo's evidence was more coincidence than fact. Still, she has amassed a fair amount of clinical data over the years and has managed to win over many of her critics. The new study, conducted by researchers at Columbia University's Center for Infection and Immunity, promises to sway many of the holdouts by providing the first conclusive evidence that strep antibodies can induce neurological and psychiatric symptoms in healthy animals.

The researchers started by injecting mice with strep bacteria. Then they injected a new set of mice with strep antibodies from the infected mice. The researchers found that not only did both sets of mice exhibit the same behavioral symptoms—including anxiety and compulsive rearing and flipping—but that the behaviors appeared to be linked to antibody deposits in brain areas that have been implicated in human studies. Other groups have attempted to induce PANDAS in animals, says James Leckman, a pediatric psychiatry researcher at Yale University, who was not involved in the study, but the results from those studies were inconsistent. "The design they used for this paper was much clearer," he says.

Mady Hornig, the principal researcher behind the Columbia study, is now working with Swedo to apply the animal findings to a clinical setting. "We hope the mouse PANDAS model can help refine the diagnostics for the human disorder," Hornig says. A more accurate method of diagnosing PANDAS could help get affected kids the right treatment—and Swedo estimates that these kids may make up as much as 25 percent of children diagnosed with OCD and tic disorders, such as Tourette syndrome. Farther down the road, the newly developed PANDAS mice could allow researchers to devise better or more specific treatments than the antibiotic regimens currently being used. *—Erica Westly*

IAN HOOTON *Photo Researchers, Inc. (sore throat); YPPS age fotostock (handwriting)*



>> COGNITION

Murder, She Wrote

Handwriting analysis may reveal dishonesty

A new study adds "writing with large strokes and applying high pressure on paper" to the list of telltale signs that someone might be lying. Researchers at Haifa University in Israel could tell whether or not students were writing the truth by analyzing these physical properties of their handwriting.

Lying requires more cognitive resources than being truthful, says lead author Gil Luria. "You need to invent a story, make sure not to contradict yourself, et cetera." Any task done simultaneously, therefore, becomes less automatic. Tabletop pressure sensors showed this effect in the students' handwriting, which became more belabored when they fibbed.

Handwriting analysis could eventually complement other lie detection methods and would add a new dimension because, unlike almost all other techniques, it doesn't rely on verbal communication, Luria says.

—Nicole Branan

Ruled by Birth Order?

For decades the evidence has been inconclusive, but new studies show that family position may truly affect intelligence and personality BY JOSHUA K. HARTSHORNE

JUDITH HAEUSLER Getty Images

WHEN I TELL PEOPLE I study whether birth order affects personality, I usually get blank looks. It sounds like studying whether the sky is blue. Isn't it common sense? Popular books invoke birth order for self-discovery, relationship tips, business advice and parenting guidance in titles such as *The Birth Order Book: Why You Are the Way You Are* (Revell, 2009). Newspapers and morning news shows debate the importance of the latest findings ("Latter-born children engage in more risky behavior; what should parents do?") while tossing in savory anecdotes ("Did you know that 21 of the first 23 astronauts into space were firstborns?").

But when scientists scrutinized the data, they found that the evidence just did not hold up. In fact, until very recently there were no convincing findings that linked birth order to personality or behavior. Our common perception that birth order matters was written off as an example of our well-established tendency to remember and accept evidence that supports our pet theories while readily forgetting or overlooking that which does not. But two studies from the past three years finally found measurable effects: our position in the family does indeed affect both our IQ and our personality. It may be time to

(The fact that astronauts are **more likely to be firstborns** could merely show that they come from smaller families.)

reconsider birth order as a real influence over whom we grow up to be.

Size Matters

Before discussing the new findings, it will help to explain why decades of research that seemed to show birth-order effects was, in fact, flawed. Put simply, birth order is intricately linked to family size. A child from a two-kid family has a 50 percent chance of being a firstborn, whereas a child from a five-kid family has only a 20 percent chance of being a firstborn. So the fact that astronauts are disproportionately firstborns, for example, could merely show that they come from smaller families—not that firstborns have any particularly astronautic qualities. (Of course, firstborns may indeed have astronautic qualities. The point is that with these data, we cannot tell.)

There are many reasons that family size could affect our predilections and personalities. More children mean that parental resources (money, time and attention) have to be spread more thinly. Perhaps more telling, family size is associated with many important social factors, such as ethnicity, education and wealth. For example, wealthier, better-educated parents typically have fewer children. If astronauts are more likely to have well-educated, comfortable parents, then they are also more likely to come from a smaller family and thus are more likely to be a firstborn.

Of the some 65,000 scholarly articles about birth order indexed by Google Scholar, the vast majority suffer from this problem, making the research difficult to interpret. Many of the few remaining studies fail to show significant effects of birth order. In 1983 psychiatrists Cecile Ernst and Jules Angst of the University of Zurich determined, after a thorough review of the literature, that birth-order effects were not supported by the evidence. In 1998 psychologist Judith Rich Harris published another comprehensive attack on the concept in *The Nurture Assumption* (Free Press). By 2003 cognitive scientist Steven Pinker of Harvard University found it necessary to spend only two pages of his 439-page discussion of nature and nurture, *The Blank Slate* (Penguin), dismissing birth order as irrelevant.

New Evidence

Even so, the case in 2003 against birth-order effects was mainly an absence of good evidence, rather than evidence of an absence. In fact, the past few years have provided good news for the theory. In 2007 Norwegian epidemiologists Petter Kristensen and Tor Bjerkedal published work showing a small but reliable negative correlation between IQ and birth order: the more older siblings one has, the lower one's IQ. Whether birth order affects intelligence has been debated inconclusively since the late 1800s, although the sheer size of the study (about 250,000 Norwegian conscripts) and the rigorous controls for family size make this study especially convincing.

In 2009 my colleagues and I published evidence that birth order influences whom we choose as friends and spouses. Firstborns are more likely to associate with firstborns, middle-borns with middle-borns, last-borns with last-borns, and only children with only children. Because we were able to show the effect independent of family size, the finding is unlikely to be an artifact of class or ethnicity. The result is exactly what we should expect if birth order affects personality. Despite the adage that opposites attract, people tend to resemble their spouses in terms of personality. If spouses correlate on personality, and personality correlates with birth order, spouses should correlate on birth order.

Thus, the evidence seems to be shifting back in favor of our common intuition that our position in our family somehow affects who we become. The details, however, remain vague. The Norwegian study shows a slight effect on intelligence. The relationship study shows that oldest, middle, youngest and only children differ in some way yet gives no indication as to *how*. Moreover, although these effects are reasonably sized by the standards of research, they are small enough that it would not make any sense to organize college admissions or dating pools around birth order, much less NASA applicants.

Still, I expect people—myself included—will continue to try to make sense of the world through the prism of birth order. It's fine for scientists to say "more study is needed," but we must find love, gain self-knowledge and parent children *now*. In that sense, a great deal about who we are and how we think *can* be learned reading those shelves of birth order–related self-help books, even if the actual content is not yet—or will never be—experimentally confirmed. M

Our position in our family somehow affects who we become. The details, however, remain vague.

JOSHUA K. HARTSHORNE is a Ph.D. student at Harvard University. He does psychological research at his Web site, www.coglanglab.org. He and his wife are both firstborns.

(Further Reading)

- **Explaining the Relation between Birth Order and Intelligence.** Petter Kristensen and Tor Bjerkedal in *Science*, Vol. 316, page 1717; June 22, 2007.
- **Birth Order Effects in the Formation of Long-Term Relationships.** Joshua K. Hartshorne, Nancy Salem-Hartshorne and Timothy S. Hartshorne in *Journal of Individual Psychology* (in press).

Reviving Consciousness

Direct stimulation of the arousal centers in patients may restore awareness

BY CHRISTOF KOCH

MOST SCHOLARS concerned with the material basis of consciousness are cortical chauvinists. They focus on the two cortical hemispheres that crown the brain. It is here that perception, action, memory, thought and consciousness are said to have their seat.

There is no question that the great specificity of any one conscious perceptual experience—such as the throbbing pain of the socket following extraction of the lower right wisdom tooth, the feeling of familiarity in déjà vu, the aha experience of sudden understanding, the azure blue of a high mountain vista, the despair at reading about one more suicide bombing—is mediated by coalitions of synchronized cortical nerve cells and their associated targets in the satellites of the cortex, thalamus, amygdala, claustrum and basal ganglia. Groups of cortical neurons are the elements that construct the content of each particular rich and vivid experience. Yet content can be provided only if the basic infrastructure to represent and process this content is intact. And it is here that the less glamorous regions of the brain, down in the catacombs, come in.

Can we help severely brain-injured patients regain some higher-level functionality?

When Consciousness Leaves

It is a general observation in neurology that injury to large chunks of cortical tissue, particularly of the so-called silent frontal lobes, can lead to a loss of specific conscious content but without any massive impairment in the victim's behavior. The patient might be unable to see in color or perhaps cannot recognize familiar faces but otherwise copes fine in daily life. But destruction of tissue the size of a sugar cube in the brain stem and in parts of the thalamus, especially if they occur simultaneously on the left and right sides, may leave the patient comatose, stuporous or otherwise unable to function. A car accident, a drug or alcohol overdose, a drive-by shooting, a near drowning, a stroke—all these events can cause consciousness to flee permanently.

A case in point was Terri Schiavo. On life support for 15 years until her court-ordered death, she was in a permanent vegetative state (VS), with a flat EEG (electroencephalograph) reading, indicative that her cortex had stopped working. Such individuals show no overt behavioral responses that rise above the level of brain stem–mediated reflexes. Two-way signaling, say, a nod in response to the question "Are you in pain?" is not possible. Less severe brain damage leads to a minimally conscious state (MCS). Although patients are still disabled, confined to bed and on a feeding tube, some sort of communication, albeit erratic and often inconsistent, occurs. Patients may be able to gesture or follow with their eyes. Awareness of their own condition and their environment is impaired and intermittent.

VS and MCS are not rare. In the U.S., up to a quarter of a million people in hospices and nursing homes hover for years in this limbo, a steep medical and emotional burden for many. This scourge is the paradoxical outcome of progress in critical care technology—mechanical ventilators, medevac helicopters, emergency room nurses and physicians, and the modern pharmaceutical cornucopia. With these tools, victims can be plucked back from the edge of death. This fate is a blessing for most, but it may be a curse for some.

Given the large number of affected individuals, you might think there is a large-scale, federally coordinated research effort under way, fostering techniques to rehabilitate the damaged brain. But you would be mistaken. For a variety of reasons, society at large has neglected this population.

Sparking a Return

Now a few hardy pioneers are finding innovative ways to help. Their technology of choice is deep-brain stimulation (DBS). The method has been much in the public eye as a way to ameliorate the symptoms of Parkinson's disease. Electrodes are implanted into a region just below the thalamus, the quail-egg-shaped structure in the center of the brain. When

CHRISTOF KOCH (*Koch*); GETTY IMAGES (*comatose patient*)

Patients can be plucked back from **the edge of death**—a blessing for most, but a curse for some.

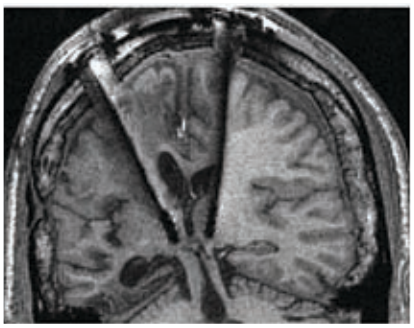
the electric current is turned on, the rigor and tremors of this movement disorder disappear instantly.

Over the past 15 years neurosurgeon Takamitsu Yamamoto and his colleagues at the Nihon University School of Medicine in Tokyo stimulated parts of the intralaminar nuclei (ILN) of the thalamus in VS and MCS patients. These regions were targeted because they are involved in producing arousal and in controlling widespread activity throughout the cortex. Indeed, according to the late neurosurgeon Joseph Bogen of the University of Southern California, the ILN is the one structure absolutely essential to consciousness.

Patients react immediately when the ILN is stimulated in this manner: they open their eyes, their pupils dilate, they make meaningless sounds, their blood pressure increases and their EEG activity desynchronizes. This arousal reaction by itself is not of therapeutic utility and does not predict recovery. But the long-term effect of such stimulation was encouraging: eight of 21 patients transitioned from the unresponsive VS to the more communicative MCS condition, and the five MCS patients who were stimulated emerged from their bedridden state, with four of them able to enjoy life back at home. Because Yamamoto exclusively targeted therapy to between three and six months after the patient's injury, however, most likely at least some of these patients would have recovered spontaneously, even without intervention.

Furthermore, it is doubtful that any type of DBS could be beneficial to the most severely affected patients, such as those in permanent VS. As a historical note, Schiavo was enrolled in one of these earlier brain-stimulation trials, but to no avail.

A recent judicious case study of a single MCS patient, however, directly demonstrated the usefulness of DBS. It was carried out by a multi-institutional team of neurologists, neurosurgeons, neuroscientists and an ethicist assembled by Nicholas D. Schiff of the Weill Cornell Medical College in New York City, Joseph T. Giacino and Kathleen Kalmar of the JFK Johnson Rehabilitation Institute in Edison, N.J., and the Cleveland Clinic in Ohio. The 38-year-old patient suffered severe brain trauma from an assault. After some initial improvement, his condition stabilized and did not change substantially over the next six years. The individual had the characteristic pattern of MCS: minimum motor control, mainly voluntary eye movements, and, infrequently, single words or other vocalizations; he could not even eat by mouth.



MRI image shows two electrodes in a patient's thalamus, through which doctors apply direct brain stimulation. The technique has restored greater awareness and the ability to eat and talk to one severely brain-injured patient in a minimally conscious state.

After implanting two electrodes in the anterior parts of the left and right ILN of the patient's thalami and after a two-month postoperative recovery period, the patient went through 11 months of on-and-off DBS therapy. The outcome was a remarkable improvement in the man's awareness and motor control. When the DBS is turned on, the patient can make hand and arm movements and can chew and swallow his own food, a major step in improving his quality of life. Most dramatically, he can communicate via gestures, words and, at times, short sentences. Some of these activities depend on ongoing electrical stimulation, implying a direct causal effect of DBS on cognitive and motor skills. Furthermore, the almost one-year-long DBS therapy has ameliorated the overall functionality of the patient's brain because some of the beneficial effects persist even when DBS is turned off. In other words, the treatment has both sustained short-term benefits as well as slowly accumulated long-term carryover effects.

One successful intervention is not a proven therapy, nor a cure for MCS, as Schiff and his colleagues caution. MCS is a very diverse syndrome, and whether any improvement occurs, and on what timescale, will depend on a host of factors, such as severity and distribution of the injury, overall condition of the patient, and so on. But if the improvement is replicated, it shows that advances in the basic neurosciences, combined with the appropriate prosthetic technology, might restore motor functions and the mechanisms supporting awareness in the brain. **M**

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FROM "BEHAVIOURAL IMPROVEMENTS WITH THALAMIC STIMULATION AFTER SEVERE TRAUMATIC BRAIN INJURY," BY NICHOLAS D. SCHIFF ET AL., IN *NATURE*, VOL. 448; AUGUST 2, 2007

A Moving Experience

How the eyes can see movement where it does not exist

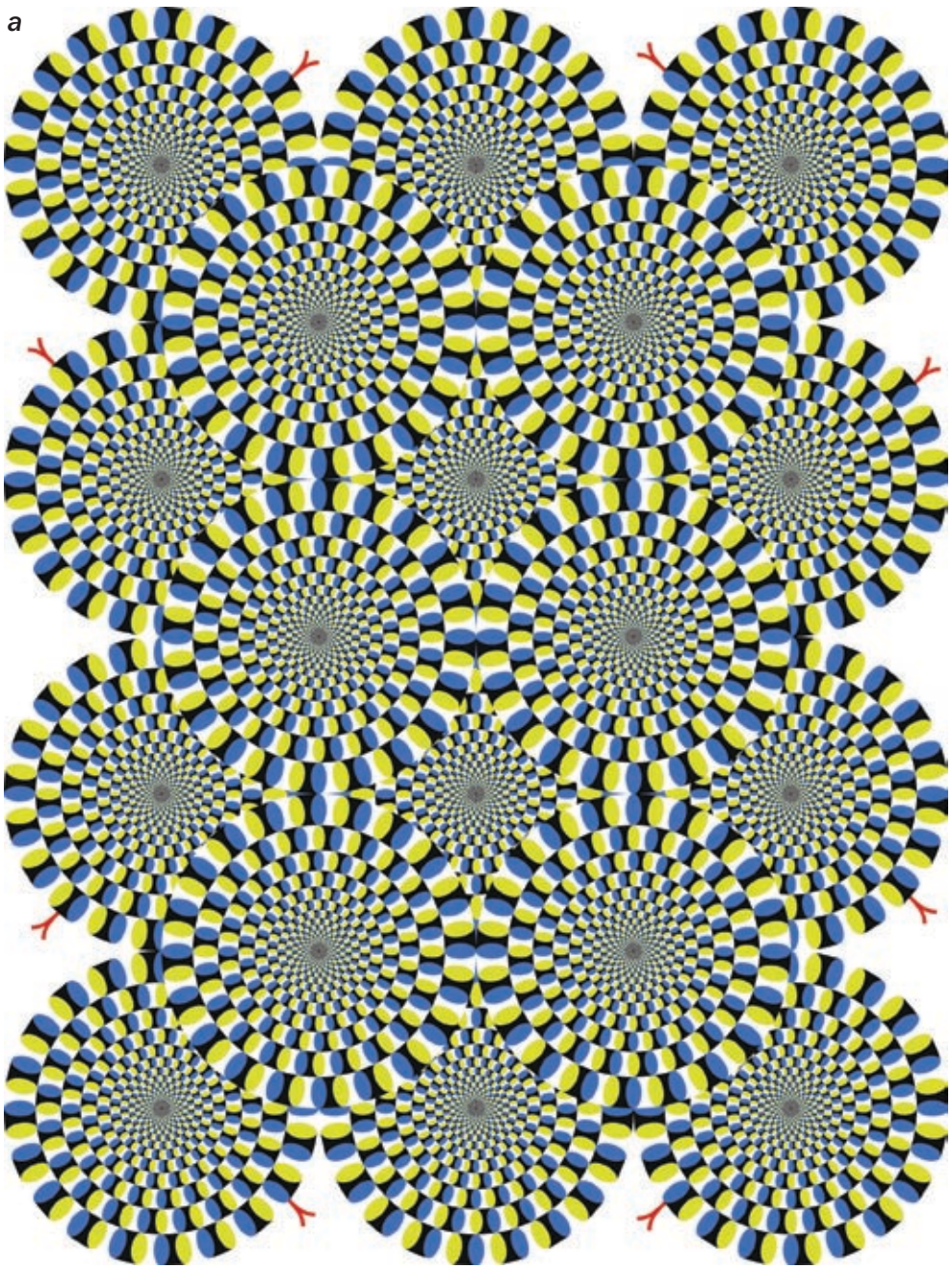
BY VILAYANUR S. RAMACHANDRAN AND DIANE ROGERS-RAMACHANDRAN

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 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?

a



AKIYOSHI KITAOKA 2003

Psychologist Akiyoshi Kitaoka of Ritsumeikan University in Kyoto, Japan, 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. 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

How is a motion-detecting neuron in the brain **"wired up"** to detect the direction of motion?

achromatic version (*b*) 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).

But why does this illusion arise? We do not know for sure. What we do 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 simply 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 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.

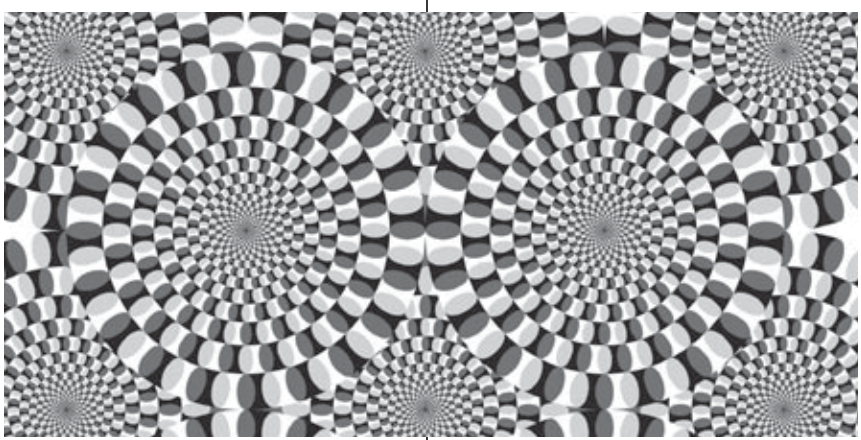
But if in the second frame you displace the dots to the right and also reverse the contrast of all the dots so that they are now white on gray (instead of black on gray), you will see motion in the opposite direction—an illusion discovered by psychologist Stuart M. Anstis, who has been at the University of California, San Diego, since 1991. 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. (Werner E. Reichardt was the founder of the Max Planck Institute for Biological Cybernetics in Tübingen, Germany.) 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 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.



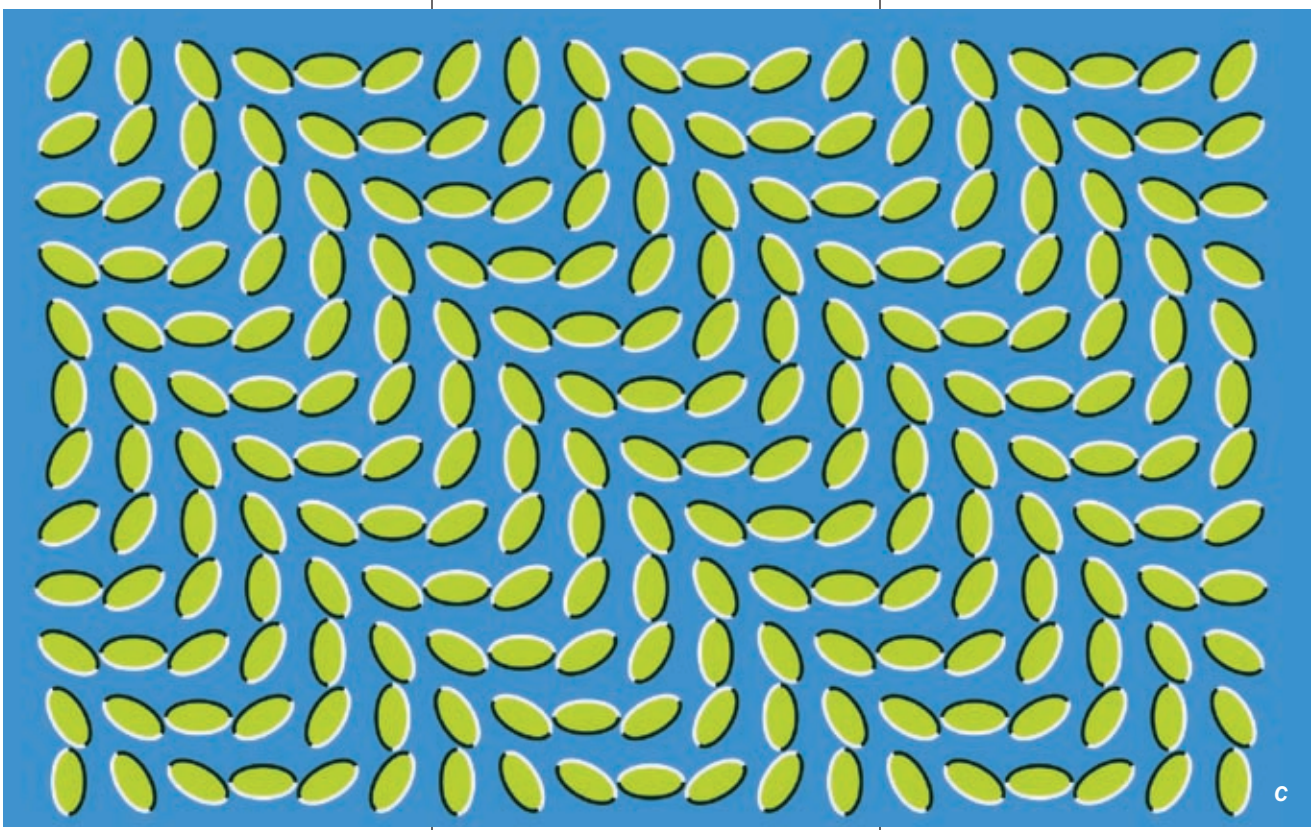
b

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 a display such as *c* 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 experi-

AKIYOSHI KITAOKA 2003

Massively parallel signals from highly repetitive patterns produce **strong illusory motion**.



ments themselves: Is the illusion any stronger with two eyes than with one? How many almondlike shapes or snakes are necessary to see them moving?

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*, *b* and *c*, 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

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This column is reprinted from an earlier issue of *Scientific American Mind*.

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- **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 et al. in *Journal of Neuroscience,* Vol. 25, No. 23, pages 5651–5656; June 8, 2005.
- Stuart M. Anstis's Web site for "reversed phi" effect: **http://psy.ucsd.edu/~sanstis/SARevMotion.html**

AKIYOSHI KITAOKA 2003

(calendar)

January

8 Most Holocaust survivors spend their lives trying to forget the horrors of the era, but neuroscientist **Eric R. Kandel,** who fled Austria in 1939 to escape the Nazis, went on to investigate how we remember. His groundbreaking research led to a new understanding of how memories are formed, eventually winning Kandel the Nobel Prize in Physiology or Medicine for his work. Now German filmmaker Petra Seeger has profiled Kandel's life in an eloquent film called ***In Search of Memory***. [For a review of the film, see page 73.]
New York City
www.ifccenter.com

21–24 Self-awareness, a goal in Buddhist practice, can now be linked to brain activity. Through discussions and lectures, participants in the Zen Brain retreat **The Self and Selflessness in Neuroscience, Buddhism, and Philosophy** at the Upaya Institute will explore the ways in which neuroscience has contributed to our grasp and practice of Buddhism.
Santa Fe, N.M.
www.upaya.org/programs/event.php?id=314

February

18–20 We know that school makes us smarter, but now neuroscience can help explain why. The 25th **Learning & the Brain** conference will investigate the factors—such as socioeconomic status, gender and stress—that contribute to or conflict with intellectual growth and consider how educators can use this understanding to teach more effectively in the classroom. Neuroscientist Richard Nisbett of the University of Michigan at Ann Arbor will speak about the best ways to boost IQ scores, and developmental molecular biologist John Medina of the University of Washington School of Medicine will discuss how stress affects memory and influences a student's performance.
San Francisco
www.learningandthebrain.com

18–20 Prisoners are up to four times as likely to suffer from mental illness as the general population. Without effective rehabilitation techniques, many people become more mentally unstable behind bars. The **Mental Health Issues and the Administration of Justice** conference will explore the ways in which imprisonment threatens mental health and how psychological illness can affect criminal proceedings, sentencing and treatment of prisoners.
Auckland, New Zealand
www.aija.org.au/index.php

25–26 Does the way a landscape is presented on a printed map or captured on film shape the way we perceive and remember it? The interdisciplinary conference **Mapping, Memory and the City** will bring together filmmakers, architects, and urban studies professionals to examine how printed maps, filmstrips and digital-mapping techniques are used to document geographic environments and how these maps mold public perception and memory of urban spaces.
Liverpool, England
www.liv.ac.uk/lsa/cityinfilm/mappingmemory

Compiled by Allison Bond and Victoria Stern. Send items to editors@SciAmMind.com

Minds **Exhibited**

Vivid photographs, 3-D sculptures of the brain and an exploration of aggression show us our inner mental machinery.

Through March 1

Have you ever wanted to see a brain up close and understand how its intricate structure works? Now you can at the Franklin Institute's **Body Worlds 2 and the Brain** exhibition, a follow-up to the popular 2005 Body Worlds show. Using real (preserved) human brains, this special presentation meant for all ages reveals the most up-to-date ideas in neuroscience from new findings on brain development and function to brain disease and disorders.
Philadelphia
www2.fi.edu/bodyworlds2

February 27–May 16

Photographer William Eggleston captures familiar objects, such as a shopping cart, a bicycle or a woman's hairstyle, with such striking colors that his work can alter a viewer's perception of these and other everyday items. The Art Institute of Chicago's retrospective of Eggleston's work, **William Eggleston: Democratic Camera, Photographs and Video 1961–2008,** challenges the mind to make sense of extraordinary presentations of the mundane.
Chicago
www.artic.edu/aic/exhibitions/exhibition/Eggleston

February 28–May 20

Aggression: It's an impulse that many of us are loathe to admit we possess, yet it manifests itself in everything from fighting in a war to pushing someone in a crowded hallway. **On Aggression,** an exhibition of various artists' work at the Philoctetes Center, explores this powerful drive and its connection to gender roles, politics and military conflict.
New York City
http://philoctetes.org/exhibitions/on_aggression

CHARLY KURZ *Laif/Redux Pictures (Kandel)*; GETTY IMAGES (*Buddha*); ROBERTO DELLA VITE *age fotostock (puppies)*

How **Science** Can Help You Fall in Love

B2M PRODUCTIONS/GETTY IMAGES (*left*); PHOTOILLUSTRATION BY AARON GOODMAN (*right*)

Nothing is more fulfilling than being in a successful love relationship. Yet we leave our love lives entirely to chance. Maybe we don't have to anymore **By Robert Epstein**

The best way to get students interested in scientific studies is to give them hands-on experiences that get them excited about the subject matter. In chemistry courses, teachers accomplish that with test tubes and mysterious liquids. In a course I taught recently at the University of California, San Diego, on relationship science, I piqued my students' interest with exercises on, well, *love*.

The researchers found that mutual eye gazing (but not gazing at hands) produced rapid increases in feelings of both liking and loving in total strangers.

To begin, I invited eight students who did not know each other to come to the front of the auditorium, where I paired them up randomly. I then asked each individual to rate, on a scale of 1 to 10, how much he or she liked, loved, or felt close to his or her partner. Then I asked the couples to look deeply into each other's eyes in an exercise I call Soul Gazing.

There was some giggling at first and then some very intense gazing. After two minutes, I again asked for the numbers. The result? A modest 7 percent increase in loving (meaning 1 point added for one person in one couple), an 11 percent increase in liking, and a whopping 45 percent increase in closeness. There were gasps and cheers in the audience. When I asked everyone in the class to pair up for two minutes of gazing, 89 percent of the students said the exercise increased feelings of intimacy.

And that was just the beginning....

Eye Contact

About 50 percent of first marriages fail in the U.S., as do two thirds of second marriages and three quarters of third marriages. So much for practice! We fail in large part because we enter into relationships with poor skills for maintaining them and highly unrealistic expectations. We also tend to pick unsuitable partners, mistakenly believing that we are in love simply because we feel physical attraction.

That combination of factors sets us up for fail-

FAST FACTS

Lessons on Love

1» About half of first marriages fail in the U.S., as do two thirds of second marriages and three quarters of third marriages. We fail in large part because we enter into relationships with poor skills for maintaining them and highly unrealistic expectations.

2» The fix for our poor performance in romantic relationships: extract a practical technology from scientific research on how people learn to love each other—and then teach individuals how to use it.

3» A study of arranged marriages in which love has grown over time hints that commitment, communication, accommodation and vulnerability are key components of a successful relationship. Other research indicates that sharing adventures, secrets, personal space and jokes can also build intimacy and love with your partner.

GETTY IMAGES (*smiling couple*); UPPERCUT IMAGES/GETTY IMAGES (*scientist*)

Love-Building Exercises

Here are some fun exercises, all inspired by scientific studies, that you can use to deliberately create emotional intimacy with a partner—even someone you barely know:

1 **Two as One.** Embracing each other gently, begin to sense your partner's breathing and gradually try to synchronize your breathing with his or hers. After a few minutes, you might feel that the two of you have merged.

2 **Soul Gazing.** Standing or sitting about two feet away from each other, look deeply into each other's eyes, trying to look into the very core of your beings. Do this for about two minutes and then talk about what you saw.

3 **Monkey Love.** Standing or sitting fairly near each other, start moving your hands, arms and legs any way you like—but in a fashion that perfectly imitates your partner. This is fun but also challenging. You will both feel as if you are moving voluntarily, but your actions are also linked to those of your partner.

4 **Falling in Love.** This is a trust exercise, one of many that increase mutual feelings of vulnerability. From a standing position, simply let yourself fall backward into the arms of your partner. Then trade places. Repeat several times and then talk about your feelings. Strangers who do this exercise sometimes feel connected to each other for years.

5 **Secret Swap.** Write down a deep secret and have your partner do the same. Then trade papers and talk about what you read. You can continue this process until you have run out of secrets. Better yet, save some of your secrets for another day.

6 **Mind-Reading Game.** Write down a thought that you want to convey to your partner. Then spend a few minutes wordlessly trying to broadcast that thought to him or her, as he or she tries to guess what it is. If he or she cannot guess, reveal what you were thinking. Then switch roles.

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7 **Let Me Inside.** Stand about four feet away from each other and focus on each other. Every 10 seconds or so move a bit closer until, after several shifts, you are well inside each other's personal space (the boundary is about 18 inches). Get as close as you can without touching. (My students tell me this exercise often ends with kissing.)

8 **Love Aura.** Place the palm of your hand as close as possible to your partner's palm without actually touching. Do this for several minutes, during which you will feel not only heat but also, sometimes, eerie kinds of sparks. —*R.E.*

ure: eventually—often within a mere 18 months—the fog of passion dissipates, and we begin to see our partner with new clarity. All too often we react by saying, "Who are *you?*" or "You've *changed*." We might try hard for years after that to keep things going, especially if children are in the picture. But if we start out with the wrong person and lack basic tools for resolving conflicts and communicating, the chances that we will succeed are slim to none.

Over the years, having looked carefully at the fast-growing scientific literature on relationship science and having conducted some new research of my own, I have come to believe that there is a definite fix for our poor performance in romantic relationships. The fix is to extract a practical technology from the research and then to teach people how to use it.

At least 80 scientific studies help to reveal how people learn to love each other. A 1989 study by psychologist James D. Laird of Clark University and his colleagues inspired my Soul Gazing exercise. The researchers showed that mutual eye gazing (but not gazing at hands) produced rapid increases in feelings of both liking and loving in total strangers. Mutual gazing is like staring, but with an important difference: for many mammalian species, staring is both intended and received as a threat. Try it on a New York subway if you have any doubts about its efficacy. In mutual gazing, however, people are giving each other *permission* to stare; that is, they are being *vulnerable* to each other, and that is the key element in emotional bonding. The vulnerability created when people are in war zones can create powerful emotional bonds in seconds, and even hostages sometimes develop strong attachments to their captors, a phenomenon called the Stockholm syndrome.

Signs of vulnerability in an animal or another person bring out tendencies in many people to provide care and protection—to be drawn to that being and to like or even love him or her. And as research

(The Author)

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"I noticed a drastic change in our bond for one another," one student wrote. "My husband seems more affectionate now than he was, for which I am really grateful."

in social psychology has shown for decades, when a person is feeling vulnerable and thus agitated or otherwise aroused, he or she often looks around for clues about how to interpret and label those feelings. The body is saying, "I'm aroused, but I'm not sure why," and the environment is suggesting an answer, namely, that you're in love.

A Technology of Affection

Soul Gazing is one of dozens of exercises I have distilled from scientific studies that make people feel vulnerable and increase intimacy. Love Aura, Let Me Inside and Secret Swap are other examples of fun, bond-building activities that any couple can learn and practice [*see box on preceding page*].

Students could earn extra credit in my course by trying out such techniques with friends, romantic interests or even total strangers. More than 90 percent of the students in the course reported using these methods successfully to improve their relationships, and more than 50 of the 213 students submitted detailed reports about their experiences. Nearly all the reports documented increases in liking, loving, closeness or attraction of between 3 and 30 percent over about a month. In a few cases, ratings tripled [*see box on opposite page*]. (Students did not need to enhance their relationships to receive extra credit; all they had to do was document their use of the techniques.)

The few exceptions I saw made sense. One heterosexual male saw no positive effects when he tried the exercises with another male; moreover, the experience made him "uncomfortable." When he tried them with a female, however, his intimacy ratings increased by 25 percent—and *hers* increased by 144 percent!

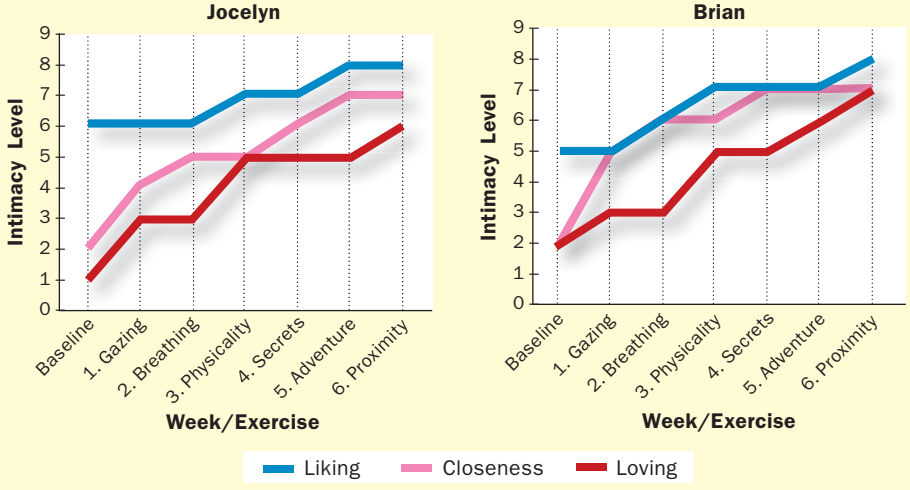
A student named Olivia attempted the exercises with her brother, mother, a good friend and a relative stranger. Soul Gazing failed with her brother because he could not stop giggling. When she and her mom tried the Secret Swap—an activity that creates vulnerability when people disclose secrets to each other—intimacy ratings increased by 31 percent. Exercises she tried with her friend boosted ratings between 10 and 19 percent, but most impressive was the outcome of gazing with someone she

When your spouse is sick or in an otherwise vulnerable state, you may feel a need to protect and care for him, drawing you closer together.

TOM STEWART *Corbis (caring for partner)*; GETTY IMAGES *(scientist)*

Extra Credit for Love

Jocelyn, aged 21, and Brian, aged 25, are students at the University of California, San Diego, where they tried some of the love-generating techniques they learned in the author's class on relationship science. These graphs show changes in feelings of liking (*blue*), closeness (*pink*) and loving (*red*) over six weeks. Each week the students tried one exercise. At the outset, they liked each other fairly well but experienced little closeness or love. In the first week, the gazing technique had a big effect on closeness, especially for Brian. By the sixth week, Jocelyn's love for Brian had risen from a 1 to a 6 on a 10-point scale, and Brian's love for Jocelyn had climbed from a 2 to a 7. Brian and Jocelyn might have made progress without the exercises, but both felt the activities had helped.



barely knew: a 70 percent increase in intimacy.

One student did the assignment with her husband of five years. The couple, Asa and Gill, tried out eight different exercises, and even though their "before" scores were usually very high (9s and 10s), every exercise they tried increased their scores by at least 3 percent. Overall, Asa wrote, "I noticed a drastic change in our bond for one another. My husband seems more affectionate now than he was, for which I am really grateful." She also reported a bonus: a substantial drop in the frequency with which she and her spouse called attention to their past mistakes. This change probably came about because the couple was now, as a result of my course, broadly interested in enhancing their relationship.

Taking Control

The students in my course were doing something new—taking *control* over their love lives. We grow up on fairy tales and movies in which magical forces help people find their soul mates, with whom they effortlessly live happily ever after. The fairy tales leave us powerless, putting our love lives into the hands of the Fates.

But here is a surprise: most of the world has never heard of those fairy tales. Instead more than half of marriages on our globe are brokered by parents or professional matchmakers, whose main concerns are long-term suitability and family harmony. In India an estimated 95 percent of the marriages are arranged, and although divorce is legal, India has one of the lowest divorce rates in the world. (This is starting to change, of course, as Western ways encroach on traditional society.)

Young couples in India generally have a choice about whether to proceed, and the combination of choice and sound guidance probably accounts for the fact that studies of arranged marriages in India indicate that they measure up well—in, for example, longevity, satisfaction and love—against Western marriages. Indeed, the love experienced by Indian couples in arranged marriages appears to be even more robust than the love people experience in "love marriages." In a 1982 study psychologists Usha Gupta and Pushpa Singh of the University of Rajasthan in Jaipur, India, used the Rubin Love Scale, which gauges intense, romantic, Western-style love, to determine that love in love marriages in India does exactly what it does in love marriages here: it starts high and declines fairly rapidly. But love in the

COURTESY OF ROBERT EPSTEIN

Studies in **Intimacy**

Dozens of scientific studies illuminate how people fall in love—and hint at techniques for building strong relationships. Here are 10 kinds of investigations that are helping to inspire a new technology of love.

1 **Arousal.** Studies by researchers such as psychologist Arthur Aron of Stony Brook University show that people tend to bond emotionally when aroused, say, through exercise, adventures or exposure to dangerous situations. Roller coaster, anyone? See the Falling in Love exercise on page 29.

2 **Proximity and familiarity.** Studies by Stanford University social psychologists Leon Festinger and Robert Zajonc and others conclude that simply being around someone tends to produce positive feelings. When two people consciously and deliberately allow each other to invade their personal space, feelings of intimacy can grow quickly. See the Let Me Inside exercise on page 29.

3 **Similarity.** Opposites sometimes attract, but research by behavioral economist Dan Ariely of Duke University and the Massachusetts Institute of Technology and others shows that people usually tend to pair off with those who are similar to themselves—in intelligence, background and level of attractiveness. Some research even suggests that merely imitating someone can increase closeness. See the Monkey Love exercise on page 29.

4 **Humor.** Marriage counselors and researchers Jeanette and Robert Lauer showed in 1986 that in long-term, happy relationships, partners make each other laugh a lot. Other research reveals that women often seek male partners who can make them laugh—possibly because when we are laughing, we feel vulnerable. Know any good jokes?

5 **Novelty.** Psychologist Greg Strong of Florida State University, Aron and others have shown that people tend to grow closer when they are doing something new. Novelty heightens the senses and also makes people feel vulnerable.

6 **Inhibitions.** Countless millions of relationships have probably started with a glass of wine. Inhibitions block feelings of vulnerability, so lowering inhibitions can indeed help people bond. Getting drunk, however, is blinding and debilitating. Instead of alcohol, try the Two as One exercise on page 29.

7 **Kindness, accommodation and forgiveness.** A variety of studies confirm that we tend to bond to people who are kind, sensitive and thoughtful. Feelings of love can emerge especially quickly when someone deliberately changes his or her behavior—say, by giving up smoking or drinking—to accommodate our needs. Forgiveness often causes mutual bonding, because when one forgives, one shows vulnerability.

8 **Touch and sexuality.** The simplest touch can produce warm, positive feelings, and a backrub can work wonders. Even getting very near someone without actually touching can have an effect. Studies by social psychologist Susan Sprecher of Illinois State University, among others, also show that sexuality can make people feel closer emotionally, especially for women. There is danger here, however: confusing sexual attraction with feelings of love. You cannot love someone without knowing him or her, and attraction blinds people to important characteristics of their partner.

Riding a roller coaster or experiencing other thrills with your partner can help you bond emotionally by boosting arousal and making you each feel vulnerable.

9 **Self-disclosure.** Research by Aron, Sprecher and others indicates that people tend to bond when they share secrets with each other. Once again, the key here is allowing oneself to be vulnerable. See the Secret Swap exercise on page 29.

10 **Commitment**. We are not that good at honoring our relationship commitments in the U.S., but studies by researchers such as psychologist Ximena Arriaga of Purdue University suggest that commitment is an essential element in building love. People whose commitments are shaky interpret their partners' behavior more negatively, for one thing, and that can be deadly over time. Covenant marriage—currently a legal option only in Arizona, Arkansas and Louisiana—is a new kind of marriage (emerging from the evangelical Christian movement) involving a very strong commitment: couples agree to premarital counseling and limited grounds for divorce. Conventional marriage in America can be abandoned easily, even without specific legal cause (the so-called no-fault divorce).

—R.E.

AGE FOTOSTOCK

arranged marriages they examined started out low and gradually *increased*, surpassing the love in the love marriage about five years out. Ten years into the marriage the love was nearly twice as strong.

How do they do it? How do people in some arranged marriages build love deliberately over time—and can we do it, too?

Over the past few years I have been interviewing people in arranged marriages in which love has grown over time. One of these couples is Kaiser and Shelly Haque of Minneapolis, who have been happily married for 11 years and have two bright, well-adjusted children. Once he had a secure life in the U.S., Kaiser, an immigrant from Bangladesh, returned to his native country to let his family know he was ready for matrimony. The family did the rest. After just one meeting with Shelly—where, Kaiser said, there was "like at first sight"—the arrangements were made. "We've grown to love each other and to get to know each other over time," Kaiser says. "The sparks are getting bigger, and I think we can do even better in the future."

Kaiser and Shelly Haque of Minneapolis met only once before their marriage was arranged in Bangladesh more than 11 years ago. Since then, the couple's love for each other has grown, an emotional trajectory that is not uncommon in arranged marriages.

A careful look at arranged marriage, combined with the knowledge accumulating in relationship science, has the potential to give us real control over our love lives.

Kaiser and Shelly are not atypical. A study that Mansi Thakar, a student at the University of Southern California, and I presented at the November 2009 meeting of the National Council on Family Relations included 30 individuals from nine countries of origin and five different religions. Their love had grown, on average, from 3.9 to 8.5 on a 10-point scale in marriages lasting an average of 19.4 years.

These individuals identified 11 factors that contributed to the growth of their love, 10 of which dovetailed beautifully with the scientific research I reviewed in my course. The most important factor was commitment, followed by good communication skills. The couples also identified sharing secrets with a spouse, as well as accommodation—that is, the voluntary altering of a partner's behavior to meet the other person's needs. Seeing a spouse in a vulnerable state (caused by injury or illness) was also singled out. There are many possible lessons here for Westerners, among them: do things deliberately that make you vulnerable to each other. Try experiencing danger, or thrilling simulations of it, as a couple. [*For more tips based on U.S. research, see box on opposite page.*]

The results conflicted with those of American studies in only one respect: several of the subjects said their love grew when they had children with their spouse. Studies in the U.S. routinely find parenting to be a threat to feelings of spousal love, but perhaps that tendency results from the strong feelings and unrealistic expectations that launch our relationships. The stress of raising children tends to disrupt those expectations and ultimately our positive feelings for each other.

Creating Love

A careful look at arranged marriage, combined with the knowledge accumulating in relationship science, has the potential to give us real control over our love lives—without practicing arranged marriage. Americans want it all—the freedom to choose a partner and the deep, lasting love of fantasies and fairy tales. We can achieve that kind of love by learning about and practicing techniques that build love over time. And when our love is fading, we can use such techniques to rebuild that love. The alternative—leaving it to chance—makes little sense. M

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- Test your relationship skills at **http://MyLoveSkills.com**

NASIR AHMED (*Haques*); GETTY IMAGES (*scientist*)

Lisa, an elementary school teacher from Ambler, Pa., came home from work one day and said to her husband, "Honey, guess what? I landed that summer teaching position I wanted!" "Wow, congratulations!" he replied. "I know how hard you worked to get that job. I am so happy for you! You must be really excited." The way Lisa's husband reacted to her good news was also good news for their marriage, which, 15 years later, is still going strong; such positive responses turn out to be vital to the longevity of a relationship.

Numerous studies show that intimate relationships, such as marriages, are the single most important source of life satisfaction. Although most couples enter these relationships with the best of intentions, many break up or stay together but languish [see "How Science Can Help You Fall in Love," by Robert Epstein, on page 26]. Yet some do stay happily married and thrive. What is their secret?

A few clues emerge from the latest research in the nascent field of positive psychology. Founded in 1998 by psychologist Martin E. P. Seligman of the University of Pennsylvania, this discipline includes research into positive emotions, human strengths and what is meaningful in life. In the past few years positive psychology researchers have discovered that thriving couples accentuate the positive in life more than those who stay together unhappily or split do. They not only cope well during hardship but also celebrate the happy moments and work to build more bright points into their lives.

It turns out that how couples handle good news may matter even more to their relationship than their ability to support each other under difficult circumstances. Happy pairs also individually experience a higher ratio of upbeat emotions to negative ones than people in unsuccessful liasions do. Cer-

BJORN ANDREN *age fotostock (married couple)*; ISTOCKPHOTO *(couple dancing)*

The Happy Couple

The key to keeping the magic alive in a marriage, experts say, is finding ways to promote the positive

By Suzann Pileggi

tain tactics can boost this ratio and thus help to strengthen connections with others. [*To measure your positivity ratio, see box on page 38.*] Another ingredient for relationship success: cultivating passion. Learning to become devoted to your significant other in a healthy way can lead to a more satisfying union.

Let the Good Times Roll

Until recently, studies largely centered on how romantic partners respond to each other's misfortunes and on how couples manage negative emotions such as jealousy and anger—an approach in line with psychology's traditional focus on alleviating deficits. One key to successful bonds, the studies indicated, is believing that your partner will be there for you when things go wrong. Then, in 2004, psychologist Shelly L. Gable, currently at the University of California, Santa Barbara, and her colleagues found that romantic couples share positive events with each other surprisingly often, leading the scientists to surmise that a partner's behavior also matters when things are going well.

In a study published in 2006 Gable and her coworkers videotaped dating men and women in the laboratory while the subjects took turns discussing a positive and negative event. After each conversation, members of each pair rated how "responded to"—how understood, validated and cared for—they felt by their partner. Meanwhile observers rated the responses on how active-constructive (engaged and supportive) they were—as indicated by intense listening, positive comments and questions, and the like. Low ratings reflected a more passive, generic response such as "That's nice, honey." Separately, the couples evaluated their commitment to and satisfaction with the relationship.

The researchers found that when a partner prof-

Mutual support and enthusiasm in *good* times are essential to a successful relationship, according to the latest research in positive psychology.

Life affords many opportunities to respond supportively to optimistic announcements: positive events happen at least three times as often as negative ones, one study suggests.

fered a supportive response to cheerful statements, the "responded to" ratings were higher than they were after a sympathetic response to negative news, suggesting that how partners reply to good news may be a stronger determinant of relationship health than their reaction to unfortunate incidents. The reason for this finding, Gable surmises, may be that fixing a problem or dealing with a disappointment—though important for a relationship—may not make a couple feel joy, the currency of a happy pairing.

In addition, couples who answered good news in an active-constructive way scored higher on almost every type of measure of relationship satisfaction than those who responded in a passive or destructive way. (Passive replies indicate a lack of interest, as in changing the subject, and destructive responses include negative statements such as "That sounds like tons of work!") Surprisingly, a passive-constructive response ("That's nice, honey") was almost as damaging as directly disparaging a partner's good news. These data are consistent with an earlier study showing that active-constructive responders experience fewer conflicts and engage in more fun activities together. These individuals also are more likely to remain together. Active-constructive responding shows that a person cares about why the good news is important, Gable says, conveying that you "get" your partner. Conversely, negative or passive reactions signify that the responder is not terribly interested—in either the news or the person disclosing it.

Thankfully, life affords many opportunities to respond supportively to optimistic announcements: Gable, along with social psychologist Jonathan Haidt of the University of Virginia, reported in 2005 that, for most individuals, positive events happen at least three times as often as negative ones. And just as responding enthusiastically to your partner's good news increases relationship satisfaction so does sharing your own positive experiences. In a daily diary study of 67 cohabiting couples (to be published in *Advances in Experimental Social*

AGE FOTOSTOCK (*couple celebrating*); ISTOCKPHOTO (*couple embracing*)

FAST FACTS

Celebration Time

1» In the past few years psychologists have discovered that thriving couples accentuate the positive in life more than those who languish or split do. They not only cope well during hardship but also celebrate the happy moments and work to build more of these into their lives.

2» How couples handle good news may matter even more to their relationship than their ability to support each other under difficult circumstances.

3» Members of happy couples also individually experience a higher ratio of upbeat emotions to negative ones than people in unsuccessful pairings do. Certain tactics can boost this ratio and thus help to strengthen bonds with others.

Psychology), Gable found that on days when couples reported telling their partner about a happy event they also reported feeling a stronger tie to their partner and greater security in their match.

Power of Positive Emotions

One of the benefits of reveling in the good times is a boost in the positive emotions of both members of a couple. A decade ago positive psychology pioneer Barbara L. Fredrickson of the University of North Carolina at Chapel Hill showed that positive emotions, even fleeting ones, can broaden our thinking and enable us to connect more closely with others. Having an upbeat outlook, she argues, enables people to see the big picture and avoid getting hung up on small annoyances. This wide-angle view often brings to light new possibilities and offers solutions to difficult problems, making individuals better at handling adversity in relationships and other parts of life. It also tends to dismantle boundaries between "me" and "you," creating stronger emotional attachments. "As positivity broadens your mind, it shifts your core view of people and relationships, bringing them closer to your center, to your heart," Fredrickson says.

When a person's positive sentiments outnumber negative feelings by three to one, that individual reaches a tipping point beyond which he or she becomes more resilient in life and love, Fredrickson found. Among individuals in enduring and mutually satisfying marriages, ratios tend to be even higher, hovering around five to one, according to research by world-renowned marriage expert John Gottman, emeritus professor of psychology at the University of Washington.

In her book *Positivity* (Crown, 2009), Fredrickson lists the 10 most frequent positive emotions: joy, gratitude, serenity, interest, hope, pride, amusement, inspiration, awe and love. Although all these emotions matter, gratitude may be one of the most important for relationships, she says. Expressing gratitude on a regular basis can help you appreciate your partner rather than taking his or her small favors or kind acts for granted, and that boost in appreciation strengthens your relationship over time. In a study in *Personal Relationships* (in press), social psychology researcher Sara B. Algoe, also at Chapel Hill, and her colleagues asked cohabiting couples, 36 percent of whom were married or engaged, to report nightly for two weeks how grateful they felt toward their partners from their interactions that day. In addition to gratitude, they numerically rated their relationship satisfaction and their feelings of connection with their partner. On days that people felt more gratitude toward their partner, they felt better about their relationship and more connected to him or her; they also experienced greater relationship satisfaction the *following* day. Additionally, their partners (the recipients of the gratitude) were more satisfied with the relationship and more connected to them on that same day. Thus, moments of gratitude may act as a booster shot for romantic relationships.

The fact that gratitude affected both partners also hints that *expressing* your gratitude is important for relationship satisfaction. To test this idea directly, Algoe, Fredrickson and their colleagues asked people in romantic relationships to list nice things their partners had done for them lately and to rate on a scale from 1 (not at all) to 7 (very much) how well they thought they had expressed appreci-

Passive responses to exuberant announcements indicate a lack of interest—and are almost as damaging to a relationship as directly disparaging a partner's good news.

AGE FOTOSTOCK

(The Author)

SUZANN PILEGGI holds a master of applied positive psychology (MAPP) from the University of Pennsylvania. She is a freelance writer and television reporter living in New York City who specializes in the cutting-edge science of happiness and how it affects our health.

How Positive Are You?

Although all healthy relationships involve some negative feelings, positive emotions form the foundation of any strong pairing. Psychologist Barbara L. Fredrickson of the University of North Carolina at Chapel Hill found that individuals who thrive in and outside relationships experience a ratio of three or more positive emotions for every negative one in their daily lives. To find out if you meet or exceed this three-to-one standard, take the following quiz, called the Positivity Self Test, developed by Fredrickson in 2009.

Instructions

Using the scale below, indicate the *greatest degree* to which you have experienced each of the following emotions during the previous 24 hours.

0 = Not at all
1 = A little bit
2 = Moderately
3 = Quite a bit
4 = Extremely

___ 1. What is the most amused, fun-loving or silly you felt?
___ 2. What is the most angry, irritated or annoyed you felt?
___ 3. What is the most ashamed, humiliated or disgraced you felt?
___ 4. What is the most awe, wonder or amazement you felt?
___ 5. What is the most contemptuous, scornful or disdainful you felt?
___ 6. What is the most disgust, distaste or revulsion you felt?
___ 7. What is the most embarrassed, self-conscious or blushing you felt?
___ 8. What is the most grateful, appreciative or thankful you felt?
___ 9. What is the most guilty, repentant or blameworthy you felt?
___ 10. What is the most hate, distrust or suspicion you felt?
___ 11. What is the most hopeful, optimistic or encouraged you felt?
___ 12. What is the most inspired, uplifted or elevated you felt?
___ 13. What is the most interested, alert or curious you felt?
___ 14. What is the most joyful, glad or happy you felt?
___ 15. What is the most love, closeness or trust you felt?
___ 16. What is the most proud, confident or self-assured you felt?
___ 17. What is the most sad, downhearted or unhappy you felt?
___ 18. What is the most scared, fearful or afraid you felt?
___ 19. What is the most serene, content or peaceful you felt?
___ 20. What is the most stressed, nervous or overwhelmed you felt?

Scoring

Circle questions 1, 4, 8, 11, 12, 13, 14, 15, 16 and 19 and then underline questions 2, 3, 5, 6, 7, 9, 10, 17, 18 and 20. Count the number of circled (positivity) questions you rated 2 or higher and the number of underlined (negativity) questions you scored 1 or higher. Divide your positivity tally by your negativity tally. (If your negativity tally is zero, replace it with a 1.) The result represents your positivity ratio for today.

If you scored below 3:1, as more than 80 percent of Americans do, you may be able to raise that ratio with exercises recommended in this article and in Fredrickson's book, *Positivity* (Crown, 2009). Because this test provides a mere snapshot of your feelings during the previous 24 hours, you may also want to repeat it nightly for two weeks to gain a more reliable assessment of your positivity ratio. (For a convenient way to test yourself, and for more details, visit www.positivityratio.com.)

ation to their partner for having done those favors. In results not yet published, the researchers found that each unit improvement in expressed appreciation decreased by half the odds of the couple breaking up in six months.

Promoting Passion

Like gratitude, feelings of passion can strengthen our bonds with others. Many people equate passion with a desperate longing, suggested by song lyrics such as "I can't live without you" and "I can't concentrate when you're not around." But such unbridled or obsessive passion is not conducive to a healthy relationship, according to work by social psychologist Robert Vallerand of the University of Quebec at Montreal. On the contrary, obsessive passion—a type that seems to control you—is as detrimental to the relationship, making it less satisfying sexually and otherwise, as having no passion.

A healthy passion—a voluntary inclination to-

AGE FOTOSTOCK

ward an activity or person that we love and value—does provide benefits, however. In a series of recent studies, using the Romantic Passion Scale, a questionnaire that measures harmonious and obsessive passion, Vallerand found that harmonious passion helps couples relate better, in part, by enabling them to become intimate with their partner while maintaining their own identity, which helps to foster a more mature partnership. Their intimacy enables them to continue to pursue their own hobbies and interests rather than subjugating their own sense of self to an excessive attachment to the other person. (Previous research by Vallerand and his colleagues revealed that harmonious passion for activities leads to cognitive and emotional advantages, such as better concentration, a more positive outlook and better mental health. No one has yet studied whether these benefits spill over to our romantic relationships, however.)

You can cultivate healthy passion by joining your partner in a pursuit that both of you enjoy, Vallerand suggests. Engaging in exhilarating activities with another person has been shown to boost mutual attraction. Avoid serious competition because the point of the outing should not be winning but enjoying time together. Another tip: write down and share with your partner some of the reasons why you love him or her and why your relationship is important.

Positive Steps

Experts also have tips for injecting positive emotions into your life. First, learn to respond constructively to your partner's positive declarations. Look for opportunities to express your interest, support and enthusiasm. Acknowledge a terrific presentation at work, say, or faster time in a road race. Ask yourself regularly: "What good news has my partner told me today? How can we celebrate it?" Affirm your partner's joy first. Discuss your concerns, such as the practical downsides of a promotion, at a later time. In addition, be attentive and actively participate in the conversation. Ask questions and indicate interest nonverbally: maintain eye contact, lean forward and nod. To show you heard, rephrase a part of what he or she said, for instance: "You seem really excited about this new job."

Moreover, a variety of exercises can boost your ratio of positive to negative emotions. Schedule exuberant feelings into your day by, say, making time for activities that evoke such emotions. Locate places you can walk to quickly to connect with nature or other beautiful scenery. Make these places regular destinations for exercising, reflecting or hanging out with friends. In addition, practice savoring a genuine source of positive emotion that is currently, has been or will be a part of your life. Truly cherish the event by focusing intently on the feelings it evokes.

Another idea for raising your personal positivity score: create a "positivity portfolio," a collection of meaningful mementos signifying a positive emotion. For example, you might encapsulate joy by creating a collage of uplifting song lyrics and pictures that make you smile. Looking at your creation every day for 20 minutes can improve your positivity score. Try infusing fun or pleasure into mundane tasks. For instance, transform dinner preparation into a family activity in which the kids help by measuring ingredients and slicing vegetables, perhaps learning about nutrition along the way, Fredrickson says. Or play romantic or fun music during the dinner-making process. Turn daily challenges or snafus, like your child's misplaced shoes, into a game to see who can find them first.

Look for opportunities to thank your partner. "Try highlighting those small moments in which your partner has been thoughtful and expressing it to him or her," Fredrickson suggests. And find time each day to share something positive that has happened to you. M

Many people equate passion with a desperate longing, but such unbridled or obsessive passion is not conducive to a healthy relationship, recent research indicates.

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Daring to DIE

WANTING TO DIE IS NOT ENOUGH TO TRIGGER SUICIDE. TO END THEIR OWN LIFE, HUMANS NEED THE GUTS AND THE MEANS TO CARRY OUT THEIR PLANS **BY KAREN SPRINGEN**

STUDIO MPM/CORBIS

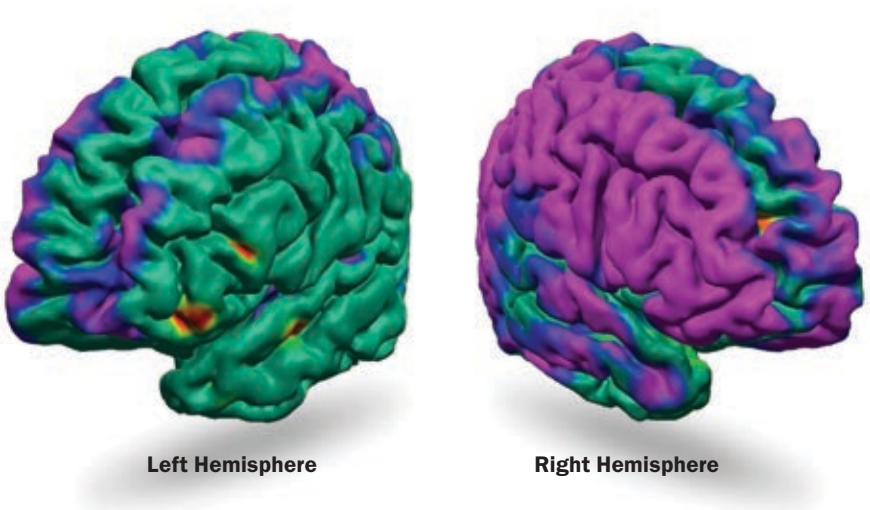
At age 18, Erica Hernandez tried to kill herself—twice. Depressed and plagued by family problems, she first took "every pill in the house," she says. Then she attempted to drink herself to death. But whether through luck or indecision, her attempts were not drastic enough to end her life before help arrived. Now age 31, Hernandez has found "peace" through her church and a parent-child psychotherapy group she has joined.

Every year millions of people around the world try to kill themselves—and nearly one million of them succeed. Suicide is the 11th biggest killer of Americans and the third-leading killer of 15- to 24-year-olds. The U.S. suicide rate is increasing for the first time in a decade, primarily as a result of the rise in the practice among whites aged 40 to 64, according to a new report covering the years 1999 to 2005 from the Center for Injury Research and Policy at the Johns Hopkins Bloomberg School of Public Health. The economy is now adding to the problem: the chief financial officer of Freddie Mac killed himself last April, and so have some Americans who have been evicted from their homes. The U.S. government's National Suicide Prevention Lifeline, begun in 2005, is also getting record numbers of calls: 57,625 in August 2009, up from 47,191 the same month a year before.

Why? Researchers are refining the traditional ideas about who is at highest risk of following through on suicidal thoughts—and how to help prevent those individuals from doing so. In particular, they are finding that a motivation to die, whether a result of depression or another mental disorder perhaps accompanied

by life circumstances, is only part of the story. "Virtually everyone who dies by suicide has a mental disorder at the time of death," says psychologist Thomas E. Joiner of Florida State University and author of *Why People Die by Suicide* (Harvard University Press, 2005) and *Myths about Suicide* (Harvard University Press, in press for 2010). "But there are millions and millions of people with mental disorders who do not die by suicide." What keeps them from carrying out this act?

It is not enough to *want* to die. To intentionally end their own life, people need the will to carry out their plans. This resolve depends on factors such as fearlessness and being able to tolerate pain and to act impulsively. The latest research shows that such fearlessness can be conditioned: those who gain experience with pain, whether from abuse by others or by their own hands, gradually improve their ability to tolerate discomfort; they also get used to the idea of harming themselves. Their risky forays can lead to suicide. Poor impulse control, sometimes fueled by alcohol or other substances, may spur suicidal acts.



In a recent study subjects prone to depression showed a 28 percent thinning of the cerebral cortex of the right hemisphere (*purple regions*) as compared with individuals not at risk for the illness. Based on psychological tests of these individuals, the researchers believe the thinner cortex leads to depression by impairing a person's ability to pay attention to and remember social cues, leading to interpersonal difficulties.

IT IS NOT ENOUGH TO *WANT* TO DIE. TO INTENTIONALLY END THEIR OWN LIFE, PLANS. "DEATH BY SUICIDE IS NEVER ABOUT ONE SINGLE THING," SAYS

"Death by suicide is never about one single thing," says Richard McKeon, the lead public health adviser for the suicide prevention branch of the U.S. Substance Abuse and Mental Health Services Administration. "Most people who lose their jobs or lose their homes don't kill themselves." But they may find themselves in a perfect suicide storm if they feel sufficiently humiliated and hopeless and possess the will—the guts, some might say—to end their life.

Experts are using this new conception of suicide risk to identify those individuals most likely to try to end it all, to target them for preventive therapy. They are also focusing anew on deterrents that simply make the act of suicide more difficult to accomplish.

FAST FACTS

The Fearless Factor

1» Every year millions of people around the world try to kill themselves—and nearly one million of them succeed. Suicide is the 11th biggest killer of Americans and the third-leading killer of 15- to 24-year-olds.

2» A motivation to die, often fueled by mental illness, is only part of the problem. To intentionally end their own life, people need the will to carry out their plans. This resolve depends on factors such as fearlessness and being able to tolerate pain and to act impulsively.

3» The latest research shows that fearlessness can be conditioned: people who gain experience with pain, whether from abuse by others or by their own hands, gradually improve their ability to tolerate discomfort; they also get used to the idea of harming themselves.

4» Poor impulse control, sometimes fueled by alcohol or other substances, may spur suicidal acts.

Signs of Sadness

Historically, suicide researchers tended to study sociological factors and mental illness, such as depression, that make people feel as though they want to die. But today they are also unearthing clues to help them identify individuals who have both lost the will to live and are most likely to carry out their plans to end it all. One risk factor for both elements is family history. In a 2002 study of 4,262 Danish suicide victims, Ping Qin and his colleagues at Aarhus University determined that hav-

BRADLEY S. PETERSON *Columbia College of Physicians and Surgeons*

ing a family history of suicide raises your chances of the same fate by two and a half times. Indeed, last year Nicholas Hughes, the son of author Sylvia Plath (who stuck her own head in a gas oven), proved that he inherited his mother's disposition to die by his own hands: he hung himself.

One dramatic recent finding revealed an anatomical warning sign of severe depression—and thus of a future desire to die. Last year psychiatrist Bradley Peterson of the Columbia College of Physicians and Surgeons and the New York State Psychiatric Institute and his colleagues reported having found a 28 percent thinning, on average, of the brain's cerebral cortex in the right hemisphere among 66 people from families with major depression as compared with 65 people from families without it, as assessed by magnetic resonance imaging. More than half the offspring of people with major depression had this structural feature, starting as young as age six.

The thinner cortex may increase the risk of developing depression by disrupting a person's ability to pay attention to and interpret social and emotional cues from other people. "The thinner the cortex in the right hemisphere, the more the people struggled with cognitive problems such as attention and memory for social stimuli," Peterson says. He theorizes that being born into a family with depression produces this cortical thinning—whether from genetics or environmental influences, he is not certain—and that thinning, in turn, leads to problems with processing social stimuli, interpersonal difficulties, depression and, all too often, suicide.

Interpersonal problems are a common precipitating event in suicide. Last August, for example, George Sodini, a 48-year-old Pennsylvania man, killed three people at a fitness club and then himself. On his Web page, he complained about years of rejection by women. "Women just don't like me," wrote Sodini, who also noted that he had not had sex for 19 years.

Deadly Experience

In the past few years researchers have looked beyond mental illness, personal problems and other motivations for wanting to die as clues to the causes of suicide. Major depression is the strongest predictor of suicidal thoughts—but not of who actually "makes an attempt," says psychologist Matthew Nock of Harvard. Suicide scientists are now investigating the triggers for the actions that lead to death itself: What causes people to go through with hurting themselves?

In 2000 a Florida inmate, John Blackwelder, incarcerated for pedophilia, wanted to kill himself but was too scared to do it. Instead, he told reporters, he strangled fellow inmate Raymond Wigley, a convicted killer, to try to get on death row. His strategy worked: on May 26, 2004, the state of Florida executed Blackwelder, then age 49, by lethal injection. "He wanted to die by suicide, but he couldn't do it himself, so he forced the state of Florida to do it," Joiner explains.

PEOPLE NEED THE WILL TO CARRY OUT THEIR SUICIDE PREVENTION EXPERT RICHARD McKEON.

The missing ingredient in his case, as in many others: fearlessness. Anyone too timid to intentionally hurt himself or herself is not at serious risk of completing a suicide attempt no matter how eager to die he or she might be. What makes some people brave enough to be at risk? One answer is experience. "Past experience of any sort that will get you used to pain or injury or death has the potential to make you more and more fearless," Joiner says. Such hazardous, frightening—and emboldening—practices include intravenous drug use, nonsuicidal self-injury and unsuccessful suicide attempts.

In particular, repeated exposure to the idea of ending your own life makes you grow more comfortable with the thought. In a 2008 summary of a study that was published in the *Journal of Consulting and Clinical Psychology*, Joiner and his colleagues wrote: "Engaging in painful and provocative experiences, including past suicide attempts, increases an individual's acquired capability for self-harm."

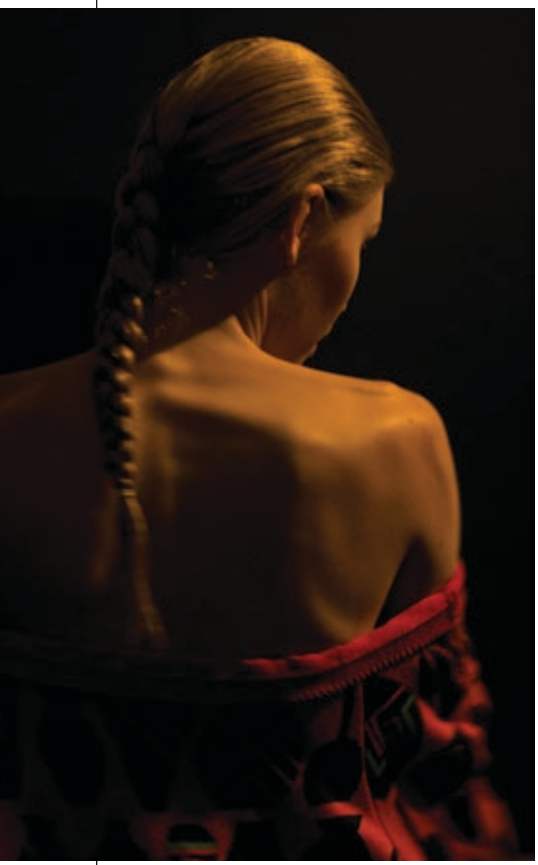
Practice with other forms of self-injury may similarly prepare a person for suicide. In a paper that appeared in the fall of 2008, researchers at the Centre Hospitalier de Sainte Anne in Paris analyzed 26 years' worth of literature on suicide, self-mutilation (cutting, bruising, burning, biting, head-banging) and borderline personality disorder (BPD—a psychiatric diagnosis characterized by unstable moods, relationships and behavior) to investigate the link, if any, between self-mutilation and suicide. They reported that more than half of people with BPD deliberately mutilate themselves and that 5 to 10 percent of BPD patients die by suicide, a rate about 400

Cutters may slice themselves with increasing vigor because they get used to pain and do not realize their actions can be deadly.

ELENA DORFMAN *Redux Pictures*

(The Author)

KAREN SPRINGEN, who is a former *Newsweek* correspondent, teaches at the Medill School of Journalism at Northwestern University and writes for many publications.



Anorexics are at high risk for suicide, perhaps in part because of their high tolerance for pain and discomfort.

ANA LAURA CASTRO *Redux Pictures*

times higher than that of the general population. The results hint that self-mutilation, especially in the context of BPD, is a risk factor for suicide. The reasons for this connection, the authors wrote, may include increased aggression among those who self-mutilate, combined with a tendency to underestimate the lethality of their behavior.

Indeed, a blasé attitude toward pain and injury can be deadly even if a person does not mean to kill himself or herself. Most people who cut themselves are not suicidal but, ironically, are trying to make themselves feel better, according to Brown University psychologist Shirley Yen. In some cases, the physical pain may provide relief from a feeling of numbness; in others, it staves off emotional pain, Yen explains. But then cutters may occasionally push the envelope—making more or deeper incisions—because they have grown accustomed to feeling injured—and may underestimate the risk of death. Such behavior can sometimes end in tragedy.

Putting Up with Pain

A person may also become used to pain and injury because of violent mistreatment from others. In a retrospective study published in 2007, Joiner and his colleagues analyzed National Comorbidity Survey data and found indications that childhood physical and violent sexual abuse should be seen as greater risk factors for future suicide attempts than nonviolent, sexual molestation and verbal abuse. Referring to Joiner's work, Harvard's Nock says, "People who have been abused or have abused themselves would habituate to the experiences of pain and acquire the ability to act on suicidal thoughts."

Some of this experience may even become etched in the brain. In a 2009 study geneticist Moshe Szyf of McGill University and his colleagues showed that childhood abuse appears to produce specific patterns of so-called epigenetic marks on the DNA of brain cells in people who later killed themselves [see "The New Genetics of Mental Illness," by Edmund S. Higgins; Scientific American Mind , June/July 2008]. Such studies highlight a biological connection between experience with abuse and suicide, although whether those epigenetic changes underlie depression or daring, or both, is unknown.

Some people acquire the fortitude to kill themselves by habituating to other forms of discomfort. Anorexics are at higher risk of suicide than people with healthy eating habits, perhaps because of their ability to withstand pain from hunger (and, in many cases, from cutting themselves as well). In a 2008 study of nine case reports of anorexics who died through suicide, Joiner and his coauthors concluded that "individuals with anorexia nervosa may habituate to the experience of pain during the course of their illness and accordingly die by suicide using methods that are highly lethal." One anorexic entered a public restroom at a gas station, stuffed towels in vents and under the door, set a trash can on fire—and died of carbon monoxide poisoning before she was found two hours later, according to a 2008 report in the *Journal of Affective Disorders*.

The danger may extend to other eating disorders, which are also, of course, associated with depression. People with eating disorders are 23 times as likely to die by suicide than people who eat normally—a statistic that makes eating disorders a *better* predictor than depression of death by suicide, says sociologist Steven Stack of Wayne State University.

A higher tolerance for pain may also partly explain why men are more likely than women to succeed in killing themselves [see "I Do Not Feel Your Pain," by Ingrid Wickelgren; Scientific American Mind, September/October 2009]. Along with a greater determination to die, a hardiness to hurt may lead men to the most lethal methods. Men prefer guns to pills, studies show, and last February researchers reported that men are more likely to shoot themselves in the head than women are. (In an investigation of the 807 firearm suicides in Wayne County, Michigan, that occurred between 1997 and 2005, Stack and his colleagues found that women were just half as likely as men to shoot themselves in the head.) The prospect of pain and disfigurement, along with a weaker will to die among women, may make females less apt to reach for such surefire weapons.

Impulsivity—which also tends to characterize men more than it does women—exacerbates the problem. After all, a release of inhibitions makes going through with plans to kill yourself easier. A major contributor to the loss of impulse control is the abuse of substances, such as alcohol, that are known to have

"PEOPLE WHO HAVE BEEN ABUSED OR WHO ABUSE ACQUIRE THE ABILITY TO ACT ON SUICIDAL THOUGHTS,"

this effect. Alcohol abuse is associated with higher rates of suicide. In fact, according to a 2003 study in the *American Journal of Psychiatry,* 4.5 percent of alcoholics attempt suicide within five years of their diagnosis of alcoholism. Other studies have found that nearly 40 percent of patients who seek treatment for alcohol abuse report having attempted suicide—a rate sixfold to 10-fold higher than that in the general population. "They use alcohol as the lubricant that allows them to take action," says Marvin Seppala, chief medical officer at Hazelden, a nonprofit addiction treatment program with facilities in Minnesota, Oregon, Illinois and New York State.

Having an impulsive personality might also help mentally prepare you to take your own life. "If you're impulsive, you will find yourself in a lot of painful and provocative situations," Joiner says. "These, in turn, habituate you to pain and fear, and so then if you develop the desire for death, you're not afraid to act on it." (The resulting suicides, however, are not impulsive but planned, he notes.)

Of course, impulsivity is just part of the equation—and, some say, a small part. In 2009 Brown University researchers reported that people who scored high in negative emotions such as anxiety, anger, fear and stress were more likely to try to kill themselves than people who scored high in impulsivity. Nevertheless, impulsivity might well act in concert with these other qualities to raise a person's risk.

Removing the Will and the Way

Because both a motivation to die and the daring to act on it are necessary ingredients of suicide, preventing this terrible ending, experts say, means combating both these elements. The federal government wants to start young on the first factor. In 2009 the Substance Abuse and Mental Health Services Administration started Project LAUNCH (Linking Actions for Unmet Needs in Children's Health) to promote the physical, emotional, social and behavioral health of kids from birth to age eight. The program aims to promote psychological well-being of children, whether or not they suffer from depression, by targeting at-risk kids.

As a way of identifying kids most likely to develop depression, Peterson's team at Columbia University is using the thinning of the brain's right cerebral cortex as an early diagnostic marker in families with a history of the illness. "There is no other test for people other than being born into a family with depression,"

THEMSELVES WOULD HABITUATE TO THE EXPERIENCES OF PAIN AND SAYS HARVARD UNIVERSITY PSYCHOLOGIST MATTHEW NOCK.

PAUL D. VAN HOY II *age fotostock*

Suicidal men choose more lethal means. They are twice as likely as women to shoot themselves in the head.

Suicide Sirens

Identifying potential suicide victims is vital for preventing them from acting on their death wishes. Although depression puts people at long-term risk of suicide, specific behaviors mark those in imminent danger of taking their own life, according to David Rudd, dean of the college of social and behavioral science at the University of Utah. A joint American Association of Suicidology and National Institutes of Health working group, which Rudd chaired, compiled a list of the most alarming suicide signs. They include:

- **Putting affairs in order.** Changing a will, for example, may be preparation for death.
- **Behaving recklessly.** People may display a death wish by, say, driving fast or running red lights. They escalate the recklessness to show they are serious.
- **Changing moods dramatically.** A person may abruptly switch from one negative emotion to another—that is, from being extremely low to being anxious or agitated.
- **Discussing suicide.** As many as 85 percent of people who kill themselves have told someone about their plans or communicated them in a poem, song or diary. Adolescents may even leave their journal out for a parent or teacher to see.
- **Talking about feeling worthless.** Abuse victims, in particular, often feel hopeless and ashamed of themselves.
- **Losing interest in life.** When a person stops caring about activities and things that once mattered to them, that emotional emptiness is a sign of escalating depression.

Peterson says. If an individual bears this brain feature, he adds, the person has an 80 percent chance of developing depression in his or her lifetime. Those people, then, might receive preventive drug treatment or psychotherapy.

Training health care professionals is also important for averting depression-induced suicides. In Nuremberg, Germany, a group reduced suicide attempts simply by educating primary care physicians about depression and encouraging them to get suicidal people straight to the emergency room. Many experts also recommend training addiction specialists in suicide, given that addiction problems boost a person's chances of killing himself or herself.

For similar reasons, young people with, or at risk of, eating disorders also need suicide-specific therapy. Correcting the distorted body images that commonly plague adolescent girls would go a long way toward preventing the sickness that leads to suicide, says Dhaval Dave, an expert in health economics and risky behavior at Bentley University and research fellow at the National Bureau of Economic Research. In addition, the one quarter of patients with eating disorders who engage in self-mutilation need to be warned that they may end up killing themselves—by accident.

Other measures discourage suicide attempts without affecting a person's desire to live. Laws that restrict the availability of alcohol appear to result in lower suicide rates. In a 2009 study in the *American Journal of Public Health*, Indiana University researcher William Pridemore and his colleagues found a significant decrease in suicides among men and women in Slovenia after a new national policy limited when and where alcohol could be sold and set the minimum drinking age at 18.

Making suicide more difficult to accomplish—say, by reducing access to so-called lethal means—can also curb its frequency. In a 2007 review psychiatrists in Copenhagen found that restricted access to firearms, domestic gas, car exhaust and barbiturates was associated with a decline in suicide rates. After the U.K. passed legislation in 1998 to reduce the number of acetaminophen tablets per package to a maximum of 16 in general stores and 32 in pharmacies, lethal poisonings from an overdose of the over-the-counter medication decreased.

Physical obstacles to suicide can also lessen its frequency. When a net went up under the Golden Gate Bridge, people could not jump to their deaths. Most did not switch to another suicide method, either. "Most people do not go for a plan

DIMAGGIO/KALISH *Corbis*

Installing a net under the Golden Gate Bridge curbed suicidal leaps off this famous overpass.

JUSTIN SULLIVAN Getty Images

B," says psychologist Mark Reinecke of Northwestern University. Adding smelly chemicals to odorless natural gas in the U.S. discouraged people from inhaling a lethal dose of it. When Britain changed its gas supply from toxic coal gas, the most common method used for suicide during the early 1960s, to nontoxic North Sea gas, its suicide rate dropped, according to an April 2009 review in the *Lancet*.

Such measures are important given the impossibility of identifying, and thwarting, every person in danger of taking his or her own life. "We have not been very good about predicting suicide or suicide attempts," says Yen, although a scientific working group has come up with a list of warning signs [*see box on opposite page*].

Hernandez never wants to see any of those signs in her daughter, Serenity. Once a week she and one-year-old Serenity attend a child-parent psychotherapy group; they also go to the Healthy Steps program at the Children's Hospital at Montefiore in New York City, which aims to prevent mental disorders in high-risk families, starting very early in life. "We get babies referred to us at two days old," says pediatrician Rahil Briggs, who directs the program. "It's prevention, prevention, prevention." M

(Further Reading)

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Are Social Networks Messing with Your Head?

Facebook, MySpace, Twitter and their cousins have evolved from college fad to global ubiquity in seven short years. Whether they are good for our mental health is another matter

BY DAVID DiSALVO

Steve is the kind of guy who likes to let everyone know what he is doing in generous detail. His Facebook page is littered with entries such as "Just finished my java mochaccino and about to walk Schnooker" and "Lost recipe for my scrumptious caramel fudge cake … super bummed … sigh." He is certain that his online friends want to know exactly what is going on in his life, and what better way to oblige them than with hourly, if not half-hourly, updates?

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It is easy to dismiss what Steve and millions of social-network users do every day as the flower of banality, but in truth they are engaged in the largest worldwide experiment in social interaction ever conducted. The Internet has always provided a loose forum for the like-minded to congregate, but social networking contributes considerable structure to the chaos, allowing people to communicate more consistently and vigorously than ever before.

In a seminal paper published in 2007, social media researchers Danah Boyd of Microsoft Research New England in Cambridge, Mass., and Nicole B. Ellison of Michigan State University offer a useful three-part definition of social-networking sites: they must provide a forum where users can construct a public or semipublic profile; create a list of other users with whom they share a connection; and view and move around their list of connections and those made by others. Sites that meet these specs include MySpace, LinkedIn, Bebo, Qzone (a massive Chinese site targeted to teens) and the global juggernaut Facebook. Others aimed at an even younger audience also fit, such as Disney's Club Penguin, where kids interact as animated characters in a vibrant online world.

Since its launch at Harvard University in 2004, Facebook has grown in membership to more than 250 million people in 170 countries and territories

Per capita use of Facebook is up 175 percent in the past year, with many users logging on to the site and those of its rivals via mobile devices.

on every continent—including Antarctica. If Facebook itself were a country, it would be the fourth most populous in the world, just behind the U.S. Almost half its users visit the site every day. Other social-networking sites are also booming. LinkedIn, a site geared for professional networkers, has more than 40 million users and adds one member every second. MySpace, the largest social network until Facebook overtook it last year, has 125 million users, and seven million Twitter users broadcast more than 18 million snippets a day to anyone who will listen. Although adolescents and college students constitute about 40 percent of social-networking users, according to iStrategyLabs in Washington, D.C., the fastest-growing segments on Facebook are Gen Xers nearing age 40 and baby boomers pushing 60.

Nielsen Online reports that social networking (and associated blogging) is now the fourth most popular online activity, ahead of personal e-mail and behind only search engines, general-interest portals such as MSN, Yahoo and AOL, and software downloads. Time spent using social-networking sites is growing at three times the rate of overall Internet usage, accounting for almost 10 percent of total time spent online.

As social networks proliferate, they are changing the way people think about the Internet, from a tool used in solitary anonymity to a medium that touches on questions about human nature and identity: who we are, how we feel about ourselves, and how we act toward one another. To better understand this phenomenon, we will investigate the newest thinking about loneliness, self-esteem, narcissism and addiction and the ways in which social networking might affect the expression of these traits. Old theories about online socializing are falling away, and fresh questions about the psychosocial relevance of social networking are constantly bubbling up.

FAST FACTS

Your Brain on Facebook

1» As social networks proliferate, they are changing the way people think about the Internet, from a tool used in solitary anonymity to a medium that touches on questions about human nature and identity.

2» If Facebook were a country, it would be the fourth most populous in the world, just behind the U.S. Almost half of its users visit every day.

3» Nielsen Online reports that social networking (and associated blogging) is now the fourth most popular online activity. Time spent on social-networking sites is growing at three times the rate of overall Internet usage, accounting for almost 10 percent of total time spent online.

4» Social networks can lessen loneliness and boost self-esteem. But they can also have the opposite effect, depending on who you are and how you use these forums.

All the Lonely People

We generally think of loneliness as physical isolation from other people. But that simple definition doesn't begin to capture the condition's pernicious nature: the deep distress people feel when they believe that their social relationships have less meaning than they should. This state can describe those of us wading through a sea of contacts on social-networking sites. Logic would have it that abundant social contacts would be a cure for the blues: the greater the number of contacts, the greater the chance of finding rewarding relationships. The truth of the matter is less straightforward.

Not so long ago the Net was presumed to be an unrelieved social backwater. "Nearly all the initial studies about people who used the Internet for social interaction suggested that they were getting lonelier," says University of Chicago social neuroscientist John Cacioppo, co-author of *Loneliness: Human Nature and the Need for Social Connection*. Those studies were predicated on the notion that people used the Internet to replace face-to-face interactions and that relationships formed online would stay online. "For disabled users who couldn't get around, that [practice] worked well," Cacioppo says, "but for others, it didn't." A person could not even know for sure who was really on the other end of the line. Psychology research focused on this scene with crit-

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The challenge of pervasive social networking is that it will supplant the richness of real-world relationships with an endless stream of trivial interactions.

WU TAO Getty Images

ical eyes, often dismissing online socializing as lonely escapism from the disquiet of real relationships.

This dire view of social networking began to change as research grew more nuanced. In a 2008 study at California State University, Los Angeles, psychologists Kaveri Subrahmanyam and Gloria Lin interviewed 192 high school students about how they used the Internet for communication, how much time they spent online and which sites they typically frequented. The study participants then completed psychological tests for assessing loneliness and social support. Neither total amount of time spent online nor time spent communicating online correlated with increased loneliness.

These results echoed those of a 2006 study at the University of Sydney by psychologist Andrew Campbell and his colleagues, who found that the amount of time spent interacting online is unrelated to higher levels of anxiety or depression—typical cohorts of loneliness. Besides appearing to be no more socially fearful than other people, heavy online users also thought their time online was psychologically beneficial to them, despite reporting that they believed Internet users overall were lonelier than average.

A connection between loneliness and social networking only emerges when the variables are flipped, and researchers study loneliness as a precursor to membership in social networks. To understand why,

In truth, the millions of social-network users are engaged in the largest experiment in social interaction ever conducted.

consider some of the recent insights into the workings of the lonely brain. A 2009 brain-imaging study by Cacioppo and his colleagues showed that the neural mechanisms of lonely and nonlonely people differ according to how they perceive social isolation, the key ingredient of loneliness. While hooked up to a functional MRI machine, the subjects viewed a series of images, some with positive connotations, such as pictures of happy people and money, and others with negative associations, such as scenes of human conflict. As the two groups watched pleasant imagery, the area of the brain that recognizes

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Social networks may spawn insecurity and anxiety in lonely people, because social threats are hard to read online. But the networks can lessen loneliness if a person's online contacts are also friends in real life.

rewards showed a greater response in nonlonely people than in lonely people. Similarly, the visual cortex of lonely test subjects responded more strongly to unpleasant images of people than to unpleasant images of objects, suggesting the attention of lonely people is especially drawn to human distress. The nonlonely showed no such difference.

These variations in brain activity hint at why a predisposition to loneliness is such a liability for social networkers. "When you're lonely, your brain is in a heightened state of alertness for social threats, even if you're not explicitly looking for them," Cacioppo explains. Insults, snubs, alienation and gossip all elicit much higher levels of stress in the lonely, measurable in part by elevated production of the stress hormone cortisol. The effect is amplified online because social threats are more difficult to anticipate there. A long silence between replies during an online chat can spawn fears that others are locking you out of the conversation and gossiping behind your back. Another source of insecurity is the very currency of social networks: the number of contacts one has. Having a mere handful of contacts when others could fill a stadium with their roster can leave lonely individuals feeling that their desires are moving ever farther out of reach.

It is not surprising, then, that the social networkers who fare the best are the ones who use the technology to support their existing friendships. In a 2007 study of older adults, gerontology doctoral student Shima Sum of the University of Sydney and her colleagues found that using social networks diminishes loneliness when online social contacts are also offline contacts. When older adults try to use social networks to meet new people, however, they consistently feel lonelier than they did before.

The social networkers who fare the best are ones who use the technology to support their existing friendships.

Indeed, face-to-face interaction appears to be the pivotal variable in social-networking effects. In a 2009 study of loneliness and Facebook membership, psychologist Laura Freberg of California Polytechnic State University and her team found that college students who are socially connected in their face-to-face lives bring that persona online and really do derive benefits. The lonely students who used the technology became lonelier.

For try as they might to put on a new set of psychic clothing, lonely people bring their true personalities online, too. A lonely and socially inept person might, for a while, assume the persona of an outgoing and gregarious conversationalist but will have a hard time sustaining the charade. "Loneliness is the deficit between what you want and what you have," Freberg says, "and chronic loneliness makes people act in ways that push others away. Social networking isn't equipped to handle that and can actually make it worse." Social networks might not make people anxious and fearful, but if they feel that way to begin with, others will know soon enough.

Looking in the Mirror

Social networks should, in theory, be a boon for people who need a boost to their self-esteem. They are ready-made venues for testing social skills without the looming embarrassment of failing in the flesh. In a 2008 study of Facebook users, social media researcher Cliff Lampe of Michigan State teased out how advantages can accrue for some online networkers. Lampe's team surveyed 477 Facebook members at the beginning and end of a one-year study period to weigh changes in various measures of psychological well-being. Facebook use correlated strongly with an increase in social capital—tangible social benefits derived from participating in a social network—especially for those with low self-

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esteem. Social capital boosts self-esteem like high-octane gas boosts a car's performance, conferring better social skills, greater feelings of contentment and increased confidence.

Positive effects were most profound for teens, who seem set to profit over the long term. "Adolescents find ways to make use of these benefits in other parts of their lives," Lampe says, most notably through a greater sense of self-confidence when interacting in person, "so there's a multiplier effect." Communications researcher Patti M. Valkenburg of the University of Amsterdam School of Communications Research in the Netherlands came to the same conclusion in a 2009 study on the social consequences of Internet use for adolescents. Membership in a social-networking site, she found, builds self-esteem by enhancing the development of friendships and the quality of existing relationships.

Adolescents do well on social networks because the context of the Internet helps to stimulate disclosure and self-presentation. Unlike face-to-face communication, social networking allows only limited visual and auditory cues. "Adolescents are less hindered by emotions and physical bothers," Valkenburg says. But not all teens will benefit. Just as for lonely social networkers, adolescents gain when they use the Internet primarily to maintain their existing network. And although using social networks tends to boost self-esteem overall, a predisposition to low self-esteem will intensify the blow from failure whether in person or online.

Perhaps because they are simple to join and make communicating so easy, social networks have become havens not only for people with a poor self-image but also for those who seem overly pleased with themselves. Indeed, a recurring criticism of social-networking sites is that they are forums for narcissists demanding the world's attention. Narcissists revel in collecting social contacts—the more the better, no matter how superficial the underlying relationships. And they hijack message boards to ensure that they are the star attraction.

But the same forum that feeds narcissists can also be their undoing. Social psychology doctoral student Laura Buffardi of the University of Georgia conducted an experiment to find out what defines online narcissists and how easily others can pick them out. Buffardi and social psychologist W. Keith

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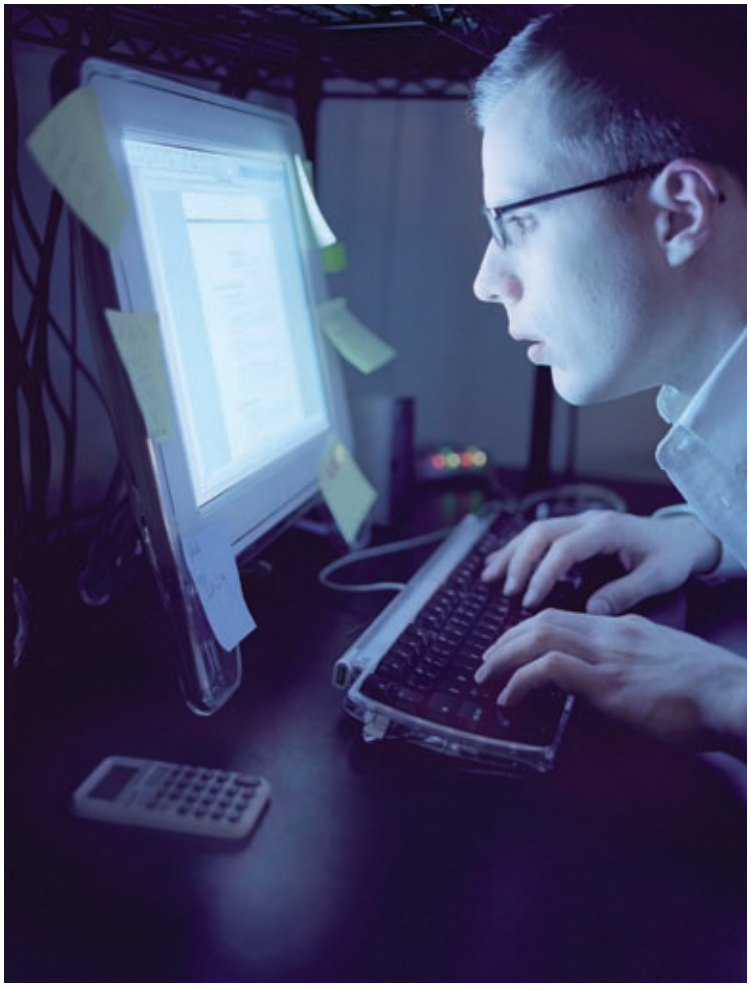
Facebook use can boost self-esteem in adolescents, stimulating disclosure and self-presentation and giving them a greater sense of self-confidence when interacting in person.

Campbell ran 130 Facebook users through the Narcissistic Personality Inventory (NPI), a research tool that measures narcissism through a questionnaire with a series of choices. Test takers select which of two statements better describes themselves—for example, "I am more capable than other people" versus "there is a lot I can learn from other people." People who score high on the NPI are more likely to cheat and game-play in relationships, monopolize resources and be excessively materialistic.

What emerged is that online narcissists behave much like offline ones, amassing numerous but shallow relationships and engaging in ceaseless self-promotion. People can generally spot them, too. When untrained strangers viewed a sample of Facebook pages, they were just as good at identifying the narcissists as previous research has found people to be at judging the personality of their friends. The observers pointed to three characteristics that they felt betrayed the narcissists: a large number of contacts, a glamorous appearance and a staged quality to the main photo.



The Internet is a magnet for people with obsessive-compulsive tendencies. Social networks can deliver the same kind of instant gratification that television and video games do.

ERIC BEAN Getty Images

Narcissists on social-networking sites may not be able to hide from their critics, but a more interesting question might be when their narcissism began: Do they arrive as fully formed egotists drawn to a stage they cannot resist, or are the sites themselves playing a role in creating narcissists? Here the research is inconclusive but intriguing. Some studies suggest that aggregate NPI scores in the U.S. have changed little since 1982; others have found significant upticks in narcissism among some groups of young adults starting in 2002—which happens to coincide with the birth of social networks. But whether the sites are a breeding ground for narcissists or just a watering hole, it is hard not to think of the spectacular rise of social networking as part and parcel of the culture of entitlement.

Overdoing It

These days people toss around the term "addiction" as casually as they would a Frisbee. But whatever you call an unhealthy attachment, people are spending ever more time on social networks, and some are getting into trouble over it. For context, Nielson Online reports that the 70 million Facebook members in the U.S. spent 233 million hours on the site in April 2009, up from 28 million hours by 23 million members the previous April—a 175 percent increase in per capita usage. And according to a study by Nucleus Research in Boston, the most avid users are spending two hours a day on the site while they are at work—helping to cost companies whose employees can access Facebook 1.5 percent of total office productivity.

It is no mystery why social networks have such a pull. Like television, video games and other forms of electronic media, social networks are superb at delivering instant gratification. Judith Donath, director of the Sociable Media Group at the Massachusetts Institute of Technology's Media Lab, says: "Social networking provides a series of mini mental rewards that don't require much effort to receive." These rewards serve as jolts of energy that recharge the compulsion engine, much like the frisson a gambler receives as a new card hits the table. Cumulatively, the effect is potent and hard to resist.

Most people will not imperil their psyches if they spend a little more time on social-networking sites. For them, two hours a day on Facebook may simply mean two hours less in front of the TV. But for people who bring a compulsive personality to the keyboard, those hours can grow rapidly, setting off a cascade of bad consequences at home and work. "Someone with obsessive-compulsive tendencies is

predisposed to a range of addictive behaviors," says neuroscientist Gary Small of the University of California, Los Angeles, and author of *iBrain: Surviving the Technological Alteration of the Human Mind*. "Technology has a way of accelerating the compulsive process." [See "Meet Your iBrain," by Gary Small and Gigi Vorgan; Scientific American Mind, October/November 2008.] In the U.S., the group at risk is pretty big: one in 50 adults has some degree of obsessive-compulsive disorder.

"Face-to-face interaction is fundamental to what we are. Its richness affects our brains," one neuroscientist says.

A consistent factor across many of the studies in this realm is that social networking is simply a new forum for bad habits. Social media researcher Scott Caplan of the University of Delaware says, "People who prefer online interaction over face-to-face interaction also score higher on measures of compulsive Internet use and using the Internet to alter their moods." In 2007 Caplan conducted a study of 343 undergraduate students to determine what stoked the fires of compulsive behavior online. He homed in on personality traits that leave people vulnerable, such as loneliness and social anxiety, and online activities that attract people with compulsive tendencies, such as playing video games, watching pornography and gambling.

Of these variables, social anxiety emerged as the strongest. "Socially anxious individuals who have problems with face-to-face interactions are drawn to the unique features of online conversation," Caplan says. In time, they may start using social networking compulsively to regulate their mood, and the self-feeding cycle begins.

Social Networking Tomorrow

Pervasive as it already seems to be, social networking is poised to invade even more areas of our lives. "We're moving into a time when the distinction between being online and offline is going to disappear," Lampe says.

The challenge will be to keep a constant deluge of social connectedness from diluting our real-world relationships by drawing us into trivial interactions. Social networking is what psychologists call a thin-strand technology, lacking many of the essential elements of communication, such as body language and touch. "The power of face-to-face interaction is fundamental to what we are," Cacioppo says. "We need the richness of it in our lives, and this richness affects our brains." Eventually, he believes, the interaction strands of social networking will grow richer. Cacioppo envisions a time when instead of communicating online in two-dimensional space, we will interact as holograms and preserve more of what makes face-to-face interaction vital.

A dynamic application we are likely to see sooner is cognitive filtering. "The social-network infrastructure is going to be baked into all sorts of different tools, most notably media-sharing services," Boyd says. Cognitive filtering will let users focus on information already vetted by their networks, saving time and aggravation. As you are flipping through movie listings on your smart phone, say, you might first see starred recommendations from your social network and then the other films whose ratings made your cutoff score. The danger is that the technology could limit the perspective of its users and breed insular thinking, turning us into a society of myopic cliques.

And that, in microcosm, is why social networking is such an important phenomenon. Beyond dessert recipes, funny pet stories and tales of what the baby did for the first time this morning, a transformational current is surging. What once seemed a faddish online application is on its way to global ubiquity. Before long, social networking may be part of every communication tool we use—changing how we interact with one another and, in the process, changing us. **M**

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Depression's Evolutionary Roots

Perhaps depression is not a malfunction but a mental adaptation that focuses the mind to better solve complex problems

By Paul W. Andrews and J. Anderson Thomson, Jr.

Why do so many people suffer from depression? Research in the U.S. and other countries estimates that between 30 to 50 percent of people have met current psychiatric diagnostic criteria for major depressive disorder sometime in their lives. This staggeringly high prevalence—compared with other mental disorders that affect only around 1 to 2 percent of the population, such as schizophrenia and obsessive-compulsive disorder—seems to pose an evolutionary paradox. The brain plays crucial roles in promoting survival and reproduction, so the pressures of evolution should have left our brains resistant to such high rates of malfunction. Mental disorders are generally rare—why isn't depression?

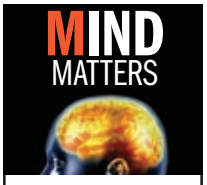
This paradox could be resolved if depression were a problem of growing old or a result of our modern lifestyles. Aging cannot explain depression, however, because people are most likely to experience their first bout in adolescence and young adulthood. So perhaps depression is like obesity—a problem that arises because modern conditions are so different from those in which our ancestors lived. But this explanation is not satisfactory, either. The symptoms of depression have been found in every culture that has been carefully examined, including societies such as the Ache of Paraguay and the !Kung of southern Africa—societies in which people are thought to live in environments similar to those that prevailed in our evolutionary past.

There is another possibility: perhaps in most instances, depression should not be thought of as a disorder at all. We believe that depression is in fact an adaptation: a state of mind that brings real costs but that also brings real benefits. During depression, the mind becomes more analytical and focused—a useful response for solving the complex problems that probably triggered the depression in the first place. If mental health professionals consider depression in this light, they will be able to better relieve the pain and suffering that accompanies it, while helping patients to work toward a real resolution of their problems.

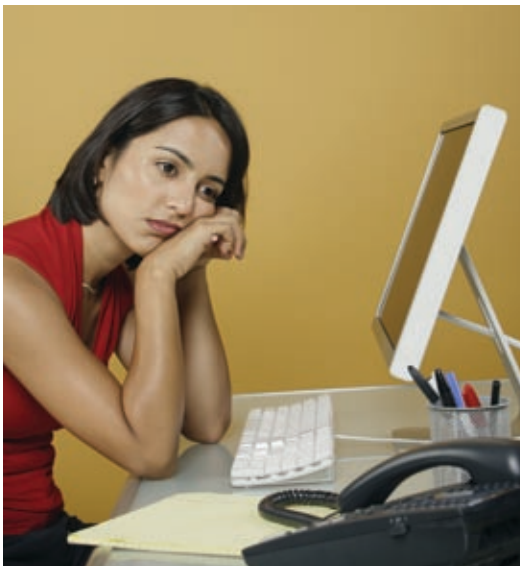
Not a Disorder

Psychiatry has struggled with defining mental disorder throughout its history. Is our modern understanding correct? Current diagnostic criteria require the presence of "clinically significant distress or impairment" for a psychological condition to be considered a mental disorder. But is this enough to ensure that a trait is a disorder?

Consider the fact that people with fever would



This article was adapted from Mind Matters, www.ScientificAmerican.com/MindMatters, a column edited by Gareth Cook, a Pulitzer Prize–winning journalist at the *Boston Globe*, and Jonah Lehrer, the science writer behind the blog The Frontal Cortex, http://scienceblogs.com/cortex



Depressed people score poorly on cognitive tests because they have difficulty concentrating on anything but their depressive ruminations.

seem to experience significant distress and impairment. They are impaired in their ability to work and think, and they often feel considerable aches and pain. But these symptoms are not reason enough to ensure that fever is a disorder. Fever is, of course, an evolved response to infection—it coordinates immune responses. It directs infection-fighting cells to tissues that are most likely to be infected, and it staggers the production of chemicals that are necessary to the immune response but could cause tissue damage if produced at the same time.

This sophisticated coordination is strong evidence that fever is an adaptation: a trait that has been shaped over evolutionary time by natural selection to perform a useful function. Indeed, various studies involving humans and nonhuman animals have shown that suppressing fever with aspirin or other medications tends to prolong the infection, and fever increases the chances of surviving a serious infection. When applied to fever, the "distress and impairment" criteria that psychiatry uses lead to erroneous conclusions about disorder—fever is not a result of the body malfunctioning; it is just the opposite.

Distress and impairment are also normally present in depression. Depression is a painful emotional condition, and depressed people often have trouble performing everyday activities. They cannot concentrate on their work, they tend to socially isolate themselves, they are lethargic, and they often lose the ability to take pleasure from such activities such as eating and sex. But this does not necessarily mean that an episode of depression is a mental disorder, any more than fever's painful symptoms mean that it is a disorder.

Even if psychiatry's definition of mental disorder is faulty, however, we need further grounds to suspect that a state of mind as debilitating as depression is an adaptation rather than a malfunction. One reason to believe depression is useful comes from research into a molecule in the brain known as the 5HT1A receptor. The 5HT1A receptor binds to serotonin, another brain molecule that is highly implicated in depression and is the target of most current antidepressant medications. Rodents lacking this receptor show fewer depressive symptoms in response to stress, which suggests that the 5HT1A receptor is somehow involved in promoting depression. When scientists compared the composition of the functional part of the rat 5HT1A receptor to that of humans, they found it is 99 percent similar, which suggests it is so vital that natural selection has preserved it through the millions of years since our common ancestor lived. The ability to "turn on" depression would seem to be important, then, rather than an evolutionary accident or the result of a malfunctioning brain.

Focused Thought

So what could be so useful about depression? Depressed people often think intensely about their problems. These thoughts are called ruminations; they are persistent, and depressed people have difficulty thinking about anything else. Numerous studies have shown that this thinking style is often highly analytical. Depressed people dwell on a complex problem, breaking it down into smaller components, which are considered one at a time.

This analytical style of thought can be very productive. Each component is not as difficult by itself, so the problem becomes more tractable. Indeed, when you are faced with a difficult problem, such

AGE FOTOSTOCK

FAST FACTS

Depressed for a Reason

1» **The brain's ability to enter a depressed state has been preserved throughout evolution, suggesting that depression is an adaptation.**

2» **Depression promotes focused rumination about problems. People in this state of mind are better at solving complex social dilemmas.**

3» **Effective therapies encourage patients to engage in rumination, allowing them to find solutions to their problems and end their depressive episode.**

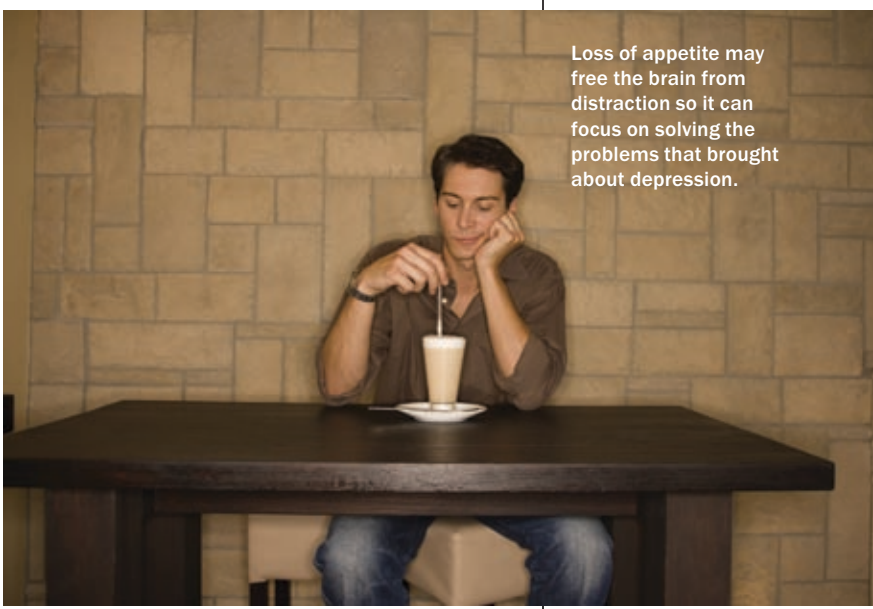
Feeling depressed is **a useful response** that may help you analyze and solve a difficult problem.

as a math problem, feeling depressed is often a useful response that may help you analyze and solve it. For instance, in some of our research, we have found evidence that people who get more depressed while they are working on complex problems in an intelligence test tend to score higher on the test.

Analysis requires a lot of uninterrupted thought, and depression coordinates many changes in the body to help people analyze their problems without getting distracted. In a region of the brain known as the ventrolateral prefrontal cortex (VLPFC), neurons must fire continuously for people to avoid being distracted. But this constant firing is very energetically demanding for VLPFC neurons, just as going up a mountain road causes a car's engine to eat up fuel. Moreover, continuous firing can cause neurons to break down, just as the car's engine is more likely to break down when overtaxed. Studies of depression in rats show that the 5HT1A receptor is involved in supplying neurons with the fuel they need to fire, as well as preventing them from breaking down. These necessary processes allow depressive rumination to continue uninterrupted with minimal neuronal damage, which may explain why the 5HT1A receptor is so evolutionarily important.

Many other symptoms of depression make sense in light of the idea that analysis must be uninterrupted. The desire for social isolation, for instance, helps the depressed person avoid situations that would require thinking about other things. Similarly, the inability to derive pleasure from sex or other activities prevents the depressed person from engaging in activities that could distract him or her from the problem. Even the loss of appetite often seen in depression could be viewed as promoting analysis because chewing and other oral activity interferes with the brain's ability to process information.

Depressive rumination is so resistant to distraction that depressed people often score lower than nondepressed people on many cognitive tasks, including tests of intelligence and reading comprehension. Abundant evidence indicates that they score lower because they are thinking about other things, which interferes with their ability to focus on the cognitive exercises that psychologists give them. Depressed people simply have trouble thinking about anything other than the problems that triggered their depression.



Loss of appetite may free the brain from distraction so it can focus on solving the problems that brought about depression.

AGE FOTOSTOCK

Social Solutions

Is there any evidence that all this rumination does any good? Most clinicians and researchers believe that depressive rumination is harmful. If this hypothesis were true, then strategies for avoiding or disrupting rumination should lead to a quicker resolution of episodes. But this prediction is not borne out by the evidence. People who try to avoid their ruminations, distracting themselves or escaping through alcohol or drugs, tend to have longer bouts of depression. Interventions that encourage rumination, however, such as expressive writing, promote a quicker resolution of depression.

Another suggestive line of evidence comes from various studies that have found that people in depressed mood states are better at solving social dilemmas—conflicts of interest with a partner on

(The Authors)

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Readers Respond

When a shorter version of this essay first appeared at www.ScientificAmerican.com, many readers left comments on the Web site asking questions or offering their thoughts. Here are two examples representing common topics of inquiry, along with the authors' responses.

Degrees of Depression

The main factor that seems to be missing from this article is an appreciation that depression varies in severity. Although the relatively milder cases might well be adaptive and, therefore, treatable via the suggested cognitive-behavior approaches outlined here, debilitative depression is an entirely different matter. Severely depressed patients are unable to perform basic tasks. They often have thoughts of suicide, which may at times lead to the only action of which they are capable. Severe depression is a complex and still superficially understood malady. Whether speculation about its evolutionary origins will lead to better treatments is an open question.

—Adapted from a comment submitted by "Detailsmatter"

THE AUTHORS REPLY: *Many commenters seem to think that our hypothesis would be most applicable to transient sadness or mild depression but not applicable to episodes that meet current diagnostic criteria for major depression, which, in their mind, are instances of disorder. We are surprised that they are quite content to believe that 30 to 50 percent of people truly have malfunctioning brains sometime in their lives and that, in most instances, the malfunctioning begins to occur in young adulthood.*

We do believe that there are true instances of depressive disorder if for no other reason than that all organs in the body are susceptible to malfunctioning. There is no reason to believe that the neurological mechanisms involved in depression are immune from malfunctioning, so depressive disorder undoubtedly exists. We simply believe that depression is overdiagnosed as a disorder—probably dramatically so.

So we use the term "depression" to refer to a range of emotional experience that encompasses transient sadness on one end and severe, even chronic, depression that would meet current diagnostic criteria for disorder on the other end. And although we do believe that depressive disorder exists, because we believe that depressive disorder is overdiagnosed we intend our arguments to apply to much of what is currently classified as depressive disorder. In our Psychological Review *article, we explain why we take this view at greater length. The short answer is that the evidence that depression promotes an analytical thinking style comes from people who meet clinical criteria as well as people with less severe symptoms.*

The Right Therapy?

If depression truly permits us to solve complex emotional problems, that fact calls into question the idea that the preferred treatment should be cognitive-behavior therapy (CBT), which proposes that depression is the result of faulty cognitive patterns that must and can be corrected. The psychoanalytic or psychodynamic approach seems much more in tune with the research that you present in your essay. In these therapeutic approaches, the central idea is to give the patient's ruminations space to be heard and to allow the patient to discover the meaning of those ruminations.

—Adapted from a comment submitted by "drhornstein"

THE AUTHORS REPLY: *Well put. In our* Psychological Review *article, we discuss the issue of CBT's efficacy in more detail. There are many experiments showing that CBT is an effective therapy for depression; however, CBT has multiple components. Attempting to change the way depressed people think about their problems is only one of these components—so in principle it is possible that this component is not therapeutic, whereas other components are. Indeed, a 1996 study by Neil Jacobson, a psychologist at the University of Washington, deconstructed CBT and found no evidence that the attempt to change the way depressed people think was therapeutic. Rather he found evidence that a different component, called behavioral activation (which attempts to keep the depressed person engaged in their social environment), was the therapeutic component.*

In a similar vein, people who report trying to cope with their depression by using various strategies to disrupt their ruminations (alcohol, distraction, thought suppression) tend to have longer, not shorter, episodes. There is even growing evidence that antidepressant medications have negative long-term effects. Although they decrease symptoms while people are taking them, once they are discontinued the risk of relapse is high. This increased risk of relapse may be because antidepressant medications interfere with depressive rumination and make it difficult to think through complex problems. Robust experimental evidence indicates that antidepressant medications make it difficult to stay focused on attentionally demanding tasks.

New talking therapies for depression are increasingly taking the strategy of not trying to fight depressive cognition. Some of these therapies focus on acceptance of the depressive process, whereas others actually encourage depressive rumination by having people explore their strongest thoughts and feelings related to their depression. These therapies are proving to be effective in treating depression.

JOSE LUIS PELAEZ, INC. *Corbis*

whom one is dependent for cooperation or help, such as a mate or a parent. These complex situations seem to be precisely the kind of problems challenging enough to require focused analysis and consequential enough to drive the evolution of such a costly state of mind.

Consider a woman with young children who discovers her husband is having an affair. Is the wife's best strategy to ignore it, or should she force him to choose between her and the other woman—and risk abandonment? Social dilemmas require careful thought and political skill, and laboratory experiments indicate that depressed people are better at solving social dilemmas by better analyzing the costs and benefits of the different options available. Research also suggests that social dilemmas are a natural trigger for depression—people who are in conflict with a cooperative partner are at high risk for depression.

When one considers all this evidence—depression being triggered by complex social problems, uninterruptible rumination helping depressed people to solve those very problems, the 5HT1A receptor's ancient ability to turn on depression and the receptor's involvement in ensuring that rumination continues uninterrupted—depression seems unlikely to be a disorder in which the brain is operating in a haphazard way. Instead depression seems like fever—an intricate, though painful, organized piece of our biology that performs a specific function. As we argue in much greater detail in our article in the July 2009 issue of *Psychological Review,* the hypothesis that depression is an adaptation is supported by evidence from many levels: genes, neurotransmitters and their receptors, neurophysiology, neuroanatomy, pharmacology, cognition, behavior, and the efficacy of treatments.

Depression undoubtedly exists as a disorder, but similar to schizophrenia and obsessive-compulsive disorder, the true rate of the disorder is probably closer to 1 to 2 percent of the population than to 30 percent. The overdiagnosis of depression may occur because sometimes people are reluctant to talk about the problem that triggered their depression. The issues at hand may be embarrassing, sensitive or painful. Some people believe they must soldier on and ignore their troubles, or they may simply have difficulty putting their complex internal struggles into words. Under such circumstances, the therapist or researcher may be more likely to believe that the depressive episode is not a normal response to life's problems but is instead the result of a malfunctioning brain.

But depression is nature's way of telling you that you have complex social problems that the mind is intent on solving. Therapies should try to encourage depressive rumination rather than trying to stop it, and they should focus on trying to help people solve the dilemmas that trigger their bouts of depression. In instances when a patient resists discussing his or her troubles or ruminations, the therapist should try to identify and dismantle those barriers. Recognizing depression's true purpose will help millions of sufferers discover the root of their painful emotions and work through their problems in a fruitful way. M

Complex social dilemmas, such as how to deal with an unfaithful partner, may trigger a depressive episode.

> Like fever, depression may be an intricate, though painful, piece of biology that performs **a specific function**.

GETTY IMAGES

(Further Reading)

- **The Bright Side of Being Blue: Depression as an Adaptation for Analyzing Complex Problems.** Paul W. Andrews and J. Anderson Thomson, Jr., in *Psychological Review,* Vol. 116, No. 3, pages 620–654; July 2009.

Driving and the Brain

Could computer software based on cognitive science improve older drivers' skills? **By Kaspar Mossman**

In the film noir classic *Double Indemnity,* insurance agents are presented as cold-blooded in their pursuit of the facts. But it wasn't until I saw a recent advertisement for Allstate, the insurance company, that I realized how seriously insurance agents take neuroscience. Allstate was advising parents to vote for graduated driver-licensing laws because teenagers' "dorsal lateral prefrontal cortexes" are immature.

There's a reason, as this ad implies, that there are age brackets for auto insurance premiums. We drive the way we do because of our brains, which start off immature, pass through an all-too-brief peak and, often, descend slowly into decrepitude.

One big factor in driving ability is how the brain processes vision. There is no doubt that overall vision declines with age. What also declines is "useful field of view" (UFOV), the area of visual field over which you can acquire information without moving your eyes or head. And smaller UFOVs have been correlated with a higher probability of getting into an accident.

Some age-related decline in visual performance is irreversible. But that doesn't mean there is nothing to be done about it. The brain is plastic, meaning it can respond to new activity by growing new connections. This is where computer training programs come in. Clinical trials such as ACTIVE, which in the late 1990s enrolled 2,802 seniors in a study of the long-term efficacy of training memory, reasoning and speed of processing, have shown that regular use of these programs can improve general cognitive function.

Something similar can happen with visual processing as well. In a 2003 paper in the journal *Nature,* psychologist Shawn Green and neuroscientist Daphne Bavelier of the University of Rochester found that playing action video games such as Medal of Honor improved markers of visual processing, including UFOV. According to Green and Bavelier, playing such games "is capable of radically altering visual attentional processing."

Two companies that provide cognitive training software also offer products for people who specifi-

EDDIE HIRONAKA *Getty Images*

GETTY IMAGES



People in different age brackets have different driving safety records, and insurance premiums reflect this disparity. Teenagers tend to be accident-prone, and skills tend to decline with age. Can computer training keep people driving safer longer?

cally want to improve their visual systems: InSight, made by PositScience in San Francisco, and Cognifit Senior Driver, by Israel's Cognifit. Previously I reviewed computer programs designed to improve cognition [see "Brain Trainers," by Kaspar Mossman; Scientific American Mind, April/May/June 2009]. Recently I tackled visual-processing software. I took InSight and DriveFit out for week-long test drives. I even roped my mother, Marie Mossman, who is 66, into trying them out, to see how they worked for their older target audience.

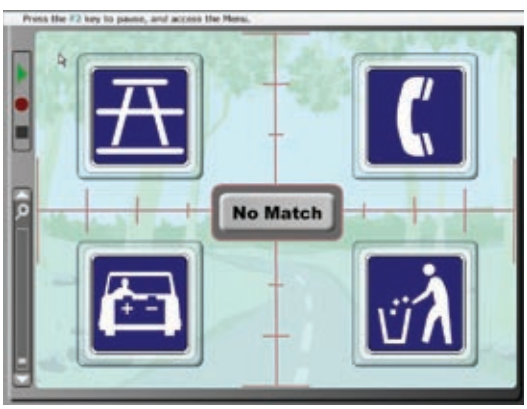
And I decided to compare these games with the popular Grand Theft Auto, after reading about a six-year-old boy in Virginia who had safely driven his mother's Ford Taurus to school at more than 60 mph. The kid had trained on Grand Theft Auto. Could this popular, fast-paced video game provide adventurous seniors with an addictive, playable alternative to training software?

Get Your Motor Running

Cognifit offers software for cognitive training and also for improving function of the visuocortical system in drivers. I tested Cognifit Senior Driver ($19.95 a month or $179 a year), which Cognifit released online in October 2009. (My mother used Golden DriveFit, an earlier CD-based version.)

First I underwent a preliminary assessment to establish a baseline. Once past this level, I encountered a range of exercises. One game was designed to strengthen "divided attention," in which you basically play the classic video game Pong while hitting the space bar each time two identical objects appear in the periphery. It puts a drag on the brain that has an eerie similarity to the way I feel when I have to make a left turn from a side street onto a busy boulevard, tracking traffic right, left and ahead. "The jury is still out on whether divided attention really exists," says Shlomo Breznitz, a professor of cognitive psychology and founder and president of Cognifit. "It could be just very effective switching" of attention from one task to another.

In its analysis of drivers' performance, Breznitz says, Cognifit found that as we age we lose the ability to spot speedy incoming objects on our right-hand side. "The preference for the left-hand side is very pronounced, especially if you have only a short time," he says, noting the phenomenon is most likely related to



Sign Posts, an exercise from Cognifit Senior Driver, increases speed of perception. A glyph flashes on-screen. You must then confirm whether the next screen contains a match.

FAST FACTS

Older Drivers at the Virtual Wheel

1» Age-related vision changes, especially a shrinking "useful field of view," can make older drivers especially dangerous behind the wheel.

2» Playing the right computer game can actually build new neurons, thicken myelin sheaths, and speed up performance in the brain's visual cortex—leading to better vision and quicker reaction time.

3» While intense action games like Grand Theft Auto can improve skills such as object-based attention, they are probably a bit too fast-paced and gory for most older drivers.

LIANE CARY *age fotostock (left)*; RANA FAURE *Getty Images (center)*; ANGELA CAMERSON *age fotostock (right)*

left-hemisphere motor dominance. The Cognifit Senior Driver game Sign Posts is designed to strengthen peripheral vision. A road sign—such as a warning that deer may be on the road—appears briefly on either the extreme left or right of the screen. Then the player is shown four signs and asked whether any of them match the first one. An algorithm adapts to any potential weakness on the right-hand side.

Cognifit Senior Driver also features an exercise that ostensibly improves hand-eye coordination by requiring you to click on a circle and maneuver it through a maze. It's a fiddly job. My mother found the coordination game hard, which is understandable. She was using a laptop with a touch pad instead of a mouse. This experience raises an important point: not many older people have an ergonomic setup, which would make the program easier to use.

Another game asks the user to estimate the relative speeds of objects moving across the screen—some shaped like cars, some not. This feature would appear eminently important for a driver, although Breznitz admits the program cannot reproduce real-life experience. "But we're not interested in simulating the real thing," he says. "We're forcing the brain to do something that is *not* like something you've done before." This aspect is, it turns out, an important theme in brain training.

Cognifit Senior Driver was hard work for me, as Golden DriveFit was for my mother. "I find practicing the games tiring," she remarks. She would be more willing to persevere if Cognifit had commercial partners that would redeem points scored for real products: "Even a latte would be a motivator for me." Breznitz says that she may have found Golden DriveFit hard because it does not have the intelligent adaptive feature that was incorporated into Cognifit Senior Driver. I tried both versions and found that whereas Cognifit Senior Driver was indeed more nimble than Golden DriveFit at matching my skill level, the basic grind of repetitive tasks remained the same in the later version.

My mother performed best on a short-term spatial-memory task featuring spaceships and worst on split attention. In defense of her generation's inability to keep up with computer-trained youth, she reminds me that youngsters have deficits, too: "Sure, older people need to work on divided attention. But maybe younger people should be working on stretching their attention spans."

After using Golden DriveFit, my mother did not immediately notice any improvement in her driving. But she lives in northern New Brunswick, Canada, where traffic is light, intersections are simple and the greatest road hazard is a wayward moose. "I can imagine that in a busy city this program would be more helpful," she offers.

When I previously reviewed brain-training programs, I found afterward that I was better able to recall phone numbers. It's as if they are on flash cards that pop up when you need them. My mother had a similar experience—an improvement in her memory, not in her driving. "I did remember a page number [in a book] that I wouldn't normally expect to," she says.

At the heart of InSight's Sweep Seeker, you must determine whether a Gabor pattern of lines (*green box*) sweeps in or out. Repeated use quickens the response of neurons downstream of the eye.

Head Out on the Highway

The next program I test-drove was InSight ($395 for PC or Mac) from PositScience. Four of the five games that make up InSight are based on exercises in a standard test developed by Karlene Ball and Dan Roenker, the academics who created the concept of UFOV. Ball and Roenker founded the company Visual Awareness to market their test to insurance companies, among other clients. PositScience has redesigned the exercises to be more fun and to improve visual memory as well as UFOV. The fifth game is Sweep Seeker, which increases the speed of cerebral neurons that receive input from the eye.

"People don't appreciate that most activities are whole brain," says Henry Mahncke, a PositScience scientist. "It's tempting to say you're targeting a tiny piece." But when you drive, more than just one brain region is involved. Your eyes send information to the primary visual cortex and other parts of the occipital lobe; processed data move to the parietal lobe, which deals with orientation and attention. The frontal lobes make decisions and command the motor cortex to stomp on the brake if a

(The Author)

KASPAR MOSSMAN is a freelance writer based in Berkeley, Calif.

The "useful field of vision" (UFOV) often declines with age, especially the ability to spot objects, such as this bike messenger, that come at the driver from the right-hand side. Studies are now assessing whether computer games that improve peripheral vision can reduce accidents.

AGE FOTOSTOCK (*bike messenger*)

pedestrian is in front of the car. "It's superimportant to understand the flow of information," Mahncke says. MRI images show that the exercises in InSight activate important regions in the visual path. In the long term, he says, "physical wet changes occur—new synapses are built, existing ones strengthened. Fatty myelin wraps axons more thickly."

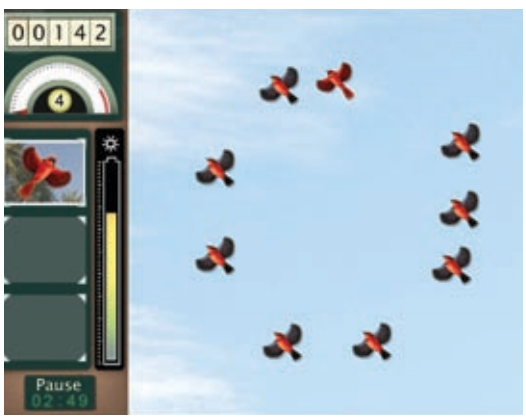
A session with InSight lasts about 45 minutes, compared with 20 minutes for Cognifit Senior Driver. You play a suite of games, and the first time you play each game, InSight subjects you to a grueling assessment. These assessments are InSight's main drawback. I found InSight much more fun to use than its older sibling, the cognitive training program Brain Fitness. But sometimes the gratification seems excessive. Every once in a while Sweep Seeker seems to play itself, as you trigger a cascade of tiles that align and evaporate—much like the orgasm of bells and lights that pinball machines can sometimes have.

The excess is deliberate, according to Michael Merzenich, co-founder and chief scientific officer of PositScience. Playing video games has been shown to release dopamine, a neurotransmitter important in reward circuitry. "It's known that symptoms of Alzheimer's often disappear when you go to Vegas," he says.

In Sweep Seeker a set of parallel lines appears on a small TV screen, and the lines move quickly to either converge or diverge; these are known as Gabor patterns. You must decide what just happened, a process designed to improve the performance of neurons in the early visual cortex. "The main thing we're trying to achieve is to get users to remember and reconstruct information spatially," Merzenich says. "That's why we pound on something as dumb as making quick decisions about lines going in or out. We're trying to improve the quality of extraction."

In Bird Safari, which targets UFOV, you see a bird at the center of the screen, and shortly afterward it disappears to be replaced by a flock of birds that flicker briefly at the periphery. You must click in the sector that contained the single bird that matched the one you were first shown. Bird Safari and Jewel Diver—a shell game in which you track jewels hidden behind bubbles that jitter around the screen—have no direct connection to driving. But, as with Cognifit Senior Driver's Pong game, when you play them you can feel mental muscles stretching like they do when you're at a five-way intersection with a complex rush-hour traffic pattern.

Unfortunately, I did not have the benefit of my mother's view of what it is like for older drivers to use this program. When she installed and tried to use InSight, some computer glitch made her repeat the first assessment over and over. "It's not the sort of thing that kids get playing and don't want to stop," she says drily. PositScience tech support was unable to solve her issue, and so she could not run the full program.



InSight's Bird Safari, which increases UFOV, asks you to click in the sector that contained the bird that did not fit in (*red-winged bird seen here at 12 o'clock*).

Grand Theft Auto Vice City, a whole-brain exercise in carjacking and carnage. Warning: may improve object-based attention.

ROCKSTAR GAMES

Looking for Adventure

"People think these programs are loosey-goosey," says Merzenich of his company's InSight. "But we're beyond that. What people don't get is that it's actually medicine, and not too far in the future they'll understand."

If brain training is medicine, Cognifit and InSight are penicillin—and Grand Theft Auto is crack. The action-packed GTA series of video games has been lambasted for gratuitous violence. But there's no denying they are fun. When I "test-drove" Grand Theft Auto, in Vice City, set in Miami, my lunch hours evaporated. Drive on the wrong side of the road, flatten pedestrians and steal their money, carjack ambulances—it lets you do *anything*. But I did wonder exactly what beneficial effect my brain might receive from my attempt to mow down 30 gang members with a submachine gun.

Bavelier, a professor of brain and cognitive sciences, has found that action video games have a remarkable and lasting effect on the visual system, one that goes far beyond the games themselves. "They're good for basic vision, attention and how you monitor the visual scene," she says. And the shooting rampages? "You get better at monitoring several different objects in your field of view—this is called object-based attention." Bavelier has found that three key factors determine the power of an action video game to improve the visual system: it must demand speed of processing; it must require flexible allocation of resources; and the user must gain self-confidence through mastery.

My mother, perhaps not surprisingly, had no interest in playing Grand Theft Auto, so I had to do the training myself. I can report that Grand Theft Auto has a considerable effect on a driver's brain. It weakens inhibitions. As I piloted the family Subaru on a shopping trip, I was more aware of pedestrians on the sidewalk, but a little voice in my head was telling me to run them over and score their cash and drugs. My better nature was appalled. Perhaps playing this game improved my object-based attention, but complex psychology was at play, making it hard to figure out whether there was a net benefit for drivers—or insurance companies—to playing this particular video game. And, no surprise, its stimulation is best suited to young men with high testosterone levels.

Coming Your Way: Discounts?

I asked clinical neuroscientist Peter Snyder whether programs such as InSight and Cognifit Senior Driver actually work at improving brain function and driving ability in older drivers. Snyder recently reviewed the brain-training scientific literature [see "Do Brain Trainer Games and Software Work?," Head Lines, by Robert Goodier; Scientific American Mind, July/August 2009]. He concluded that only PositScience was justified in claiming that its cognitive training product worked.

The problem, according to Snyder, is that it is difficult to measure improvements in specific tasks, because the tests to do so are too similar to the tasks themselves. But with visual processing (as opposed to cognition), Snyder says, it is likely that we will be able to get a straight answer, because the training—in games such as Jewel Diver—is so different from actual driving. As for whether either program helps to improve driving, he says that "it's a hell of a lot easier to measure progress in a driving simulator than to design studies to determine whether older people think better." He is "guardedly optimistic" that InSight and Cognifit Senior Driver might work as their makers claim.

To establish whether using these programs to improve driving skills really works, Allstate has partnered with PositScience in an ongoing study. More than 5,000 Allstate customers in Pennsylvania, all older than 50, trained with InSight; the company is currently comparing the accident numbers of these drivers with those of a control group.

"If completing the software does indeed improve driving," says Krissy Posey, an Allstate spokesperson, "Allstate hopes to offer discounts to drivers." The flip side is that premiums will probably rise for those who fail the UFOV test or can't complete InSight. But those who would call this unfair will face insurance agents as implacable as Barton Keyes, claims adjuster for the fictitious Pacific All-Risk in *Double Indemnity,* who was certain that Phyllis Dietrichson's husband could not possibly have fallen to his death from a slow-moving train. M

Do the "Eyes" Have It?

Eyewitness testimony is fickle and, all too often, shockingly inaccurate

BY HAL ARKOWITZ AND SCOTT O. LILIENFELD

Eyewitnesses often try to pick out a perpetrator from a police lineup—and frequently make devastating mistakes.

COURTESY OF HAL ARKOWITZ (*top*); COURTESY OF SCOTT O. LILIENFELD (*bottom*); AGE FOTOSTOCK (*lineup*)

IN 1984 KIRK BLOODSWORTH was convicted of the rape and murder of a nine-year-old girl and sentenced to the gas chamber—an outcome that rested largely on the testimony of five eyewitnesses. After Bloodsworth served nine years in prison, DNA testing proved him to be innocent. Such devastating mistakes by eyewitnesses are not rare, according to a report by the Innocence Project, an organization affiliated with the Benjamin N. Cardozo School of Law at Yeshiva University that uses DNA testing to exonerate those wrongfully convicted of crimes. Since the 1990s, when DNA testing was first introduced, Innocence Project researchers have reported that 73 percent of the 239 convictions overturned through DNA testing were based on eyewitness testimony. One third of these overturned cases rested on the testimony of two or more mistaken eyewitnesses. How could so many eyewitnesses be wrong?

Eyewitness identification typically involves selecting the alleged perpetrator from a police lineup, but it can also be based on police sketches and other methods. Soon after selecting a suspect, eyewitnesses are asked to make a formal statement confirming the ID and to try to recall any other details about events surrounding the crime. At the trial, which may be years later, eyewitnesses usually testify in court. Because individuals with certain psychological disorders, such as antisocial personality disorder and substance dependence, are at high risk for criminal involvement, they are also at heightened risk for false identifications by eyewitnesses.

Surveys show that most jurors place heavy weight on eyewitness testimony when deciding whether a suspect is guilty. But although eyewitness reports are sometimes accurate, jurors should not accept them uncritically because of the many factors that can bias such reports [*see box on opposite page*]. For example, jurors tend to give more weight to the testimony of eyewitnesses who report that they are very sure about their identifications even though most studies indicate that highly confident eyewitnesses are generally only slightly more accurate—and sometimes no more so—than those who are less confident. In ad-

dition to educating jurors about the uncertainties surrounding eyewitness testimony, adhering to specific rules for the process of identifying suspects can make that testimony more accurate.

Reconstructing Memories

The uncritical acceptance of eyewitness accounts may stem from a popular misconception of how memory works. Many people believe that human memory works like a video recorder: the mind records events and then, on cue, plays back an exact replica of them. On the contrary, psychologists have found that memories are reconstructed rather than played back each time we recall them. The act of remembering, says eminent memory researcher and psychologist Elizabeth F. Loftus of the University of California, Irvine, is "more akin to putting puzzle pieces together than retrieving a video recording." Even questioning by a lawyer can alter the witness's testimony because fragments of the memory may unknowingly be combined with information provided by the questioner, leading to inaccurate recall.

Many researchers have created false memories in normal individuals; what is more, many of these subjects are certain that the memories are real. In one well-known study, Loftus and her colleague Jacqueline Pickrell gave subjects written accounts of four events, three of which they had actually experienced. The fourth story was fiction; it centered on the subject being lost in a mall or another public place when he or she was between four and six years old. A relative provided realistic details for the false story, such as a description of the mall at which the subject's parents shopped. After reading each story, subjects were asked to write down what else they remembered about the incident or to indicate that they did not remember it at all. Remarkably about one third of the subjects reported partially or fully remembering the false event. In two follow-up interviews, 25 percent still claimed that they remembered the untrue story, a figure consistent with the findings of similar studies.

Error-Prone IDs

A number of factors can reduce the accuracy of eyewitness identifications. Here are some of them:

- **Extreme witness stress** at the crime scene or during the identification process.
- **Presence of weapons** at the crime (because they can intensify stress and distract witnesses).
- **Use of a disguise** by the perpetrator such as a mask or wig.
- **A racial disparity** between the witness and the suspect.
- **Brief viewing times** at the lineup or during other identification procedures.
- **A lack of distinctive characteristics** of the suspect such as tattoos or extreme height.

Adapted from "Expert Testimony regarding Eyewitness Identification," by B. L. Cutler and G. L. Wells, in *Psychological Science in the Courtroom: Consensus and Controversy.* Edited by Jennifer L. Skeem, Kevin S. Douglas and Scott O. Lilienfeld. Guilford Press, 2009.

Given the dangers of mistaken convictions based on faulty eyewitness testimony, how can we minimize such errors? The Innocence Project has proposed legislation to improve the accuracy of eyewitness IDs. These proposals include videotaping the identification procedure so that juries can determine if it was conducted properly, putting individuals in the lineup who resemble the witness's description of the perpetrator, informing the viewer of the lineup that the perpetrator may or may not be in it, and ensuring that the person administering the lineup or other identification procedure does not know who the suspect is. Although only a few cities and states have adopted laws to improve the accuracy of eyewitness identifications, there seems to be a growing interest in doing so.

Expert Testimony

In addition, allowing experts on eyewitness identification to testify in court could educate juries and perhaps lead to more measured evaluation of the testimony. Most U.S. jurisdictions disallow such experts in courtrooms on the grounds that laboratory-based eyewitness research does not apply to the courtroom and that, in any case, its conclusions are mostly common sense and therefore not very enlightening. Yet psychologist Gary Wells of Iowa State University and his colleague Lisa Hasel have amassed considerable evidence showing that the experimental findings do apply to courtroom testimony and that they are often counterintuitive.

Science can and should inform judicial processes to improve the accuracy and assessment of eyewitness accounts. We are seeing some small steps in this direction, but our courts still have a long way to go to better ensure that innocent people are not punished because of flaws in this very influential type of evidence. M

HAL ARKOWITZ and SCOTT O. LILIENFELD serve on the board of advisers for *Scientific American Mind*. Arkowitz is a psychology professor at the University of Arizona, and Lilienfeld is a psychology professor at Emory University.

Send suggestions for column topics to editors@SciAmMind.com

(Further Reading)

- **Eyewitness Identification: Issues in Common Knowledge and Generalization.** Gary L. Wells and Lisa E. Hasel in *Beyond Common Sense: Psychological Science in the Courtroom.* Edited by E. Borgida and S. T. Fiske. Wiley-Blackwell, 2007.
- **Eyewitness Testimony: Civil and Criminal.** Fourth edition. Elizabeth F. Loftus. LexisNexis, 2007.
- **Psychological Science in the Courtroom: Consensus and Controversy.** Edited by Jennifer L. Skeem, Kevin S. Douglas and Scott O. Lilienfeld. Guilford Press, 2009.

CORBIS

I Learned It at the Movies

Even films that are historically inaccurate can be a valuable teaching tool

BY WRAY HERBERT

IN THE 2003 MOVIE *The Last Samurai (above),* Tom Cruise plays a former U.S. Army captain named Nathan Algren, an alcoholic and mercenary who in the 1870s goes to Japan to work for the Emperor Meiji. The young emperor is facing a samurai rebellion, and Algren trains a ragtag bunch of farmers and peasants in modern warfare, including the use of rifles. When Algren is captured by the samurai, however, he is gradually converted to their ways and ends up fighting alongside the warriors in a losing battle against the Imperial Army he helped to create.

The movie was both a critical and popular success, and why not? It offers lots of exciting swordplay, exotic costumes and a fascinating piece of history that was probably unfamiliar to most Americans before the film was released. Indeed, it's fair to say that many Americans have learned much of what they know about the westernization of Japan from watching films such as *The Last Samurai.*

That's probably not a good thing, because the film is full of historical errors. Most notably, it was the French and Dutch, not Americans, who played the key role in Japan's modernization in the late 19th century. The Algren character is loosely based on a French officer named Jules Brunet. What's more, the movie conflates two decades of military history for the sake of simplicity and presents a highly romanticized view of the samurai warriors.

I know, I know. *The Last Samurai* is not a documentary, and people go to the

> The vividness of film did help the students create **stronger memories** of the material.

MATT MENDELSON (*Herbert*); SEAN LOCKE /*Stockphoto (classroom scene*); COURTESY OF DAVID JAMES *Warner Bros./The Kobal Collection (screen shot of* The Last Samurai)

When the information in the film was inaccurate, the students were more likely to recall the film's **distorted version**.

movies to be entertained, not to be instructed in history. No argument there. But films such as *The Last Samurai* are increasingly used in the classroom as well, as adjuncts to textbooks and lectures. Educators believe that the vividness of film can be a valuable teaching tool, enlivening and reinforcing students' memories for otherwise dry historical text. But is that a good thing if the facts are wrong? Are they doing more harm than good?

A team of psychologists has begun exploring these questions experimentally. Andrew Butler of Washington University in St. Louis and his colleagues decided to simulate a classroom where popular films are used as a teaching tool, to see if the practice improved or distorted students' understanding. *The Last Samurai* was in fact one of the films they used in the experiment, along with *Amadeus, Glory, Amistad* and a few others. All the films contained both accurate and inaccurate information about the historical incidents they depicted.

The students watched the film clips either before or after they read an accurate version of the historical events. So with *The Last Samurai,* for example, they read a version that accurately identified the hero as French, not American, and was faithful to the actual timeline of Japanese history. In addition, some of the students received a general warning about the inaccuracy of popular historical films, whereas others got very specific warnings—for instance, about changing the hero's nationality. The idea was to see which teaching method led to the most accurate comprehension of the events: reading or watching a movie, or both, with or without the teacher's commentary.

When the psychologists tested all the students a week later, the verdict for classroom movies was one thumb up, one thumb down. Watching the films did clearly help the students learn more, but only when the information was the same in both text and film. Apparently the vividness of the film (and simply having a second version of the same facts) did help the students create stronger memories of the material. But when the information in the film and the reading were contradictory—that is, when the film was inaccurate—the students were more likely to recall the film's distorted version. What's more, they were very confident in their memories, even though they were wrong. This happened even when the students were warned that filmmakers often play fast and loose with the facts.

SAUL ZAENTZ COMPANY/THE KOBAL COLLECTION (*Amadeus*); ANDREW COOPER *Dreamworks LLC/The Kobal Collection* (*Amistad*)

Movies such as *Amadeus* (*top*) and *Amistad* (*bottom*) contain historical inaccuracies, but as long as teachers point out the discrepancies in detail, students will retain the correct facts.

So should films be banned from the classroom? Not necessarily, and here's why. As the psychologists reported in September in the journal *Psychological Science,* a good teacher can trump a movie's shortcomings. They found that when teachers gave the very detailed warnings about inaccuracies in the film version, the students got it. But those warnings had to be extremely precise, something such as: "Pay attention when you watch the film, and you'll see that the filmmaker has changed the nationality of the hero from French to American, which is not the way it was." With such warnings, the students apparently "tagged" the information as false in their memories—and remembered the accurate version when quizzed later on.

In this sense, a movie's distorted version of history can be used as a teachable moment. Students learn the truth by identifying the mistakes and labeling them, so their takeaway learning is: the film says this, but in fact it's that. Not a bad way to learn, assuming the classroom teacher knows enough to point out what's this and that. M

For more insights into the quirks of human nature, visit the "We're Only Human. . ." blog and podcasts at www.psychologicalscience.org/onlyhuman

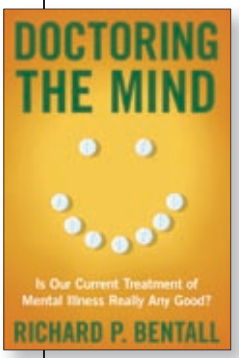
WRAY HERBERT is director of public affairs for the Association for Psychological Science.

(Further Reading)

- **Using Popular Films to Enhance Classroom Learning: The Good, the Bad, and the Interesting.** Andrew C. Butler, Franklin M. Zaromb, Keith B. Lyle and Henry L. Roediger III in *Psychological Science,* Vol. 20, No. 9, pages 1161–1168; September 2009.
- **Historical Inaccuracies in Popular Films** (online slide show at the Washington University in St. Louis Web site): **http://news-info.wustl.edu/tips/page/normal/14418.html**

books

TROUBLED PRACTICES



Doctoring the Mind: Is Our Current Treatment of Mental Illness Really Any Good?

by Richard P. Bentall. New York University Press, 2009 ($29.95)

Despite advances in our understanding of mental illness, treatments leave patients no better off today than they did almost half a century ago—according to British clinical psychologist Richard P. Bentall. In his provocative book, *Doctoring the Mind,* Bentall takes on the conventional field of psychiatry, arguing that it works in a way that is "profoundly unscientific" and fails to actually help patients who are suffering from mental problems.

The root of the problem is psychiatry's heavy focus on the biomedical approach, which, research shows, is "fatally flawed," Bentall writes. Antipsychotic drugs are not working well, and the impression that they do is actually the result of "skillful pharmaceutical industry marketing," he claims. The same is true for antidepressants, Bentall says, citing studies that found appalling methodological flaws in the drugs' clinical testing. For example, in some studies "patients were removed and replaced by new patients if they failed to show an early response to the antidepressant."

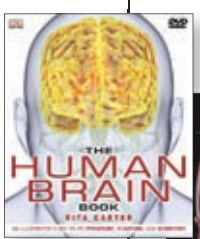
But it's not only the treatments that ail the field of mental health care; the diagnoses themselves can be equally problematic, Bentall says. That's because the current system of categorizing psychiatric problems is fundamentally wrong, he argues. For example, many patients show both bipolar and schizophrenia symptoms, blurring the boundaries between the two disorders. Such diagnoses, then, are "about as scientifically meaningful as star signs."

Doctoring the Mind is a very accessible and well-organized book, but what makes it most engaging is the glimpse inside the world of mental illness that Bentall's patient stories provide. His accounts illustrate the point that a conventional approach often leaves doctors stumbling blindly in the dark. Some of the stories are so bewildering that it is hard to comprehend how they happened. One example is Andrew, who was brought into a facility for psychiatric examination. Presumably in an attempt to find behaviors that fit a diagnosis, health care professionals focused on the fact that Andrew was "excessively polite." One of the reasons for keeping him in the institution, then, became to work out whether his politeness was "part of his normal personality or his illness."

So what does it take for mental health care to get on the right track? Bentall thinks part of the answer is taking into account the circumstances that most likely led to mental problems in the first place. But rather than trying to make broad diagnoses such as schizophrenia, we should look at individual symptoms, he says. For example, research has already elucidated potential experiences that may contribute to the development of paranoia. Such an approach, however, would require nothing less than "completely rethinking the values and goals of psychiatric care."

—*Nicole Branan*

A REMARKABLE TOME



The Human Brain Book

by Rita Carter. Dorling Kindersley, 2009 ($40)

Don't let the rich, colorful illustrations fool you into thinking this book is for kids. *The Human Brain Book* packs an astonishing amount of information between its oversized covers, proving interesting and informative for both experts brushing up on the basics and newbies looking to learn more about the brain.

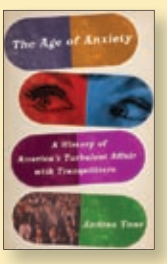
This gem can serve as a reference to answer brain-related questions, from the complex organ's function and structure to the disorders that can afflict it. The book's innovative graphics and diagrams also provide a unique way of looking at the brain; for example, one section separates and spreads out the layers in a graphical head, allowing the reader to view the dissected anatomy comprising the head and neck, including the brain stem, the skull and the intricate lace of nerves woven just beneath the scalp.

The *Brain Book* is also just plain fun to browse, thanks to the variety of topics relevant to each of us in real life, from the sections about how we sense pain, to the neurobiology of desire and reward, to how the creative process can change the brain's chemistry. Fun might not be a term that comes to mind often when considering reference books; that's why *The Human Brain Book* proves itself unique among educational texts.

—*Allison Bond*

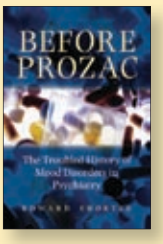
» Mental Health: A Historical View

From lobotomy to antidepressants to scream therapy, the methods used to treat mental disorders have changed dramatically in the past century. Drug fads, commercialization and many other influences have shaped the way we diagnose and remedy mental illness. These recent releases illuminate the past to better inform our understanding of mental health today.



In the early 1950s the pharmaceutical industry questioned whether there would be a market for antianxiety drugs, Andrea Tone explains in ***The Age of Anxiety: A History of America's Turbulent Affair with Tranquilizers.*** By 1957, 36 million prescriptions for the first such drug—Miltown—had been filled, making it the first ever blockbuster drug and kicking off the rush for psychopharmaceutical gold.

In ***Before Prozac: The Troubled History of Mood Disorders in Psychiatry,*** Edward Shorter questions whether we are indeed moving forward in making the diagnosis and treatment of mental illness more effective. Shorter ques-



television

DIVIDED SHE FALLS

The United States of Tara

Showtime

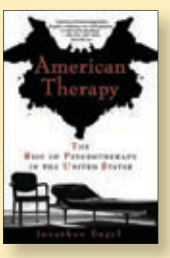
www.sho.com/site/tara/home.do

Spend half an hour with Tara, the beloved main character in the television series *United States of Tara,* and you'll also meet beer-chugging "Buck," demure "Alice," reclusive "Gimme" and teen terror "T," who steals skimpy tops from Tara's daughter's closet. They have little in common, except for their eyes, family and therapist. These eccentrics are all part of Tara's personality—she suffers from dissociative identity disorder (DID), a condition formerly known as multiple personality disorder, which may result from childhood trauma.

Each episode weaves Tara's personalities into, and abruptly out of, everyday family life. One day Tara is dutifully driving her gay son to high school, and the next T is disturbingly making out with his unrequited crush. "It's a reminder that the illness takes a toll on family and friends as much as it does the patient," says David Spiegel, associate chair of psychiatry at the Stanford University School of Medicine. Yet, he says, Hollywood has taken some liberties with this portrayal of DID. "My patients don't change costumes when they go into other identities."

The first season ended ominously. At a bowling alley, Tara leans on her husband's shoulder as she watches her kids cheer each other on and says, "You know, it could get worse before it gets better." She's right. The more disturbed a patient is, the more fragments she'll have, Spiegel explains. "The problem is not that patients have more than one identity but that they have fewer than one identity." There's no doubt Toni Collette, who won an Emmy for her portrayal, can deftly take on more characters this upcoming season, but can Tara?

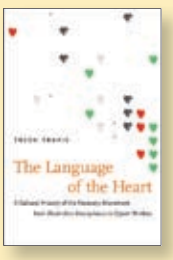
—Corey Binns



tions the definition of depression itself and argues that power struggles—not science—have decided the drugs prescribed to treat it.

American Therapy: The Rise of Psychotherapy in the United States, by Jonathan Engel, delineates a broader history of mental health treatments. Beginning with the rise of psychoanalysis, Engel eventually arrives at today's focus on targeted treatment, which he argues has spawned a field fueled by pleasing consumers through unnecessary drugs such as Zoloft (sertraline, an antidepressant) and trendy remedies such as primal scream therapy.

Another popular form of treatment that has undergone intense commercialization is group support therapy, which began with Alcoholics Anonymous. In ***The Language of the Heart: A Cultural History of the Recovery Movement from Alcoholics Anonymous to Oprah Winfrey,*** Trysh Travis traces the rise of group therapy, suggesting that it ultimately offers ways to prevail over fundamental culture-based problems.



Compiled by Allison Bond.

film

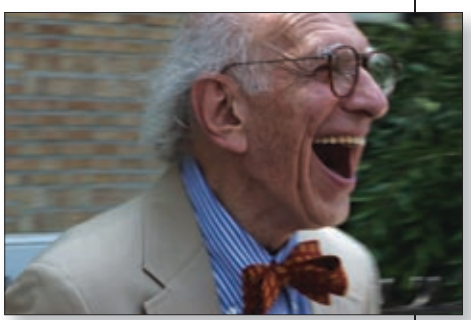
A SCIENTIST REFLECTS

In Search of Memory

Icarus Films, 2008

http://icarusfilms.com/new2009/mem.html

Despite its broad title, the documentary *In Search of Memory* is quite narrowly focused. In fact, the film's subject, Nobel laureate Eric R. Kandel (*below*), serves as both narrator and star and appears in nearly every shot. With a lead character as dynamic and charming as Kandel, however, it is easy to see why director Petra Seeger chose to build the film on his personal experiences and reflections, rather than engaging in the



usual documentary-style interviews with colleagues, friends and family. Based on Kandel's 2006 autobiography of the same title, the movie chronicles his groundbreaking memory research as well as his early childhood in Nazi-occupied Austria (Kandel's family fled to the U.S. in 1939).

Seeger interweaves Kandel's musings on the science of memory with personal accounts and reenactments of his childhood. She takes the viewer into Kandel's laboratory at Columbia University for light science lessons and then to Austria where Kandel and his family revisit the locations of his childhood traumas for the first time. Even in these poignant scenes, Kandel's effervescence shows through. With his trademark red bow tie and his wide smile, Kandel never ceases to be a pleasure to watch. He is one of science's greatest treasures, and Seeger does a masterful job at encapsulating both his brilliance and his captivating spirit.

—Erica Westly

askthe**Brains**

How are memories saved? Where does the recording take place and how?

—Michael Saayman, Cape Town, South Africa

Michael Rugg, director of the Center for the Neurobiology of Learning and Memory at the University of California, Irvine, provides an explanation:

UNDERSTANDING EXACTLY how the brain encodes and stores memories is one of the central, unsolved mysteries in neuroscience. Currently the most widely accepted theory is long-term potentiation (LTP)—the lasting communication established between two neurons when they are stimulated simultaneously.

As a person processes an event, two neurons pass information through a small space called a synapse. This chemical conversation triggers an intricate cascade, inviting nearby neurons to fire and ultimately creating a network of connections with varying strengths. Afterward, this pattern of connections, or memory, remains within the network of neurons that processed the event.

Although many areas of the brain contain synapses capable of creating strong patterns of connectivity, the hippocampus is a particularly favorable spot for recording memories. This brain region plays a critical role in learning new information, forming spatial memories and storing short-term memories as long-term ones.

Memories formed with the hippocampus are especially rich because they integrate input from several areas of the brain, and the hippocampus contains densely packed layers of neurons. In addition, damage to this region and nearby areas causes profound and permanent amnesia—an inability to store new memories or to recall old ones—and is observed in patients who have Alzheimer's disease.

How does background noise affect our concentration?

—Philip Miele, Dublin, Ohio

Mark A. W. Andrews, director and professor of physiology at Lake Erie College of Osteopathic Medicine at Seton Hill University in Greensburg, Pa., offers a reply:

BACKGROUND OR LOW-LEVEL noise in the home, work or school often disrupts people's concentration. According to the National Institute for Occupational Safety and Health, ambient noise also affects people's health by increasing general stress levels and aggravating stress-related conditions such as high blood pressure, coronary disease, peptic ulcers and migraine headaches. Continued exposure does not lead to habituation; in fact, the effects worsen.

Several studies have indicated that stress resulting from ongoing white noise can induce the release of cortisol, a hormone that helps to restore homeostasis in the body after a bad experience. Excess cortisol impairs function in the prefrontal cortex—an emotional learning center that helps to regulate "executive" functions such as planning, reasoning and impulse control. Some recent evidence indicates that the prefrontal cortex also stores short-term memories. Changes to this region, therefore, may disrupt a person's capacity to think clearly and to retain information.

Though not definitive, recent research also suggests that noise-induced stress may decrease dopamine availability in the prefrontal cortex, where the hormone controls the flow of information from other parts of the body. Stress resulting from background noise, then, may decrease higher brain function, impairing learning and memory. M

Have a question? Send it to editors@SciAmMind.com

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(*2*) Mailed in-county paid subscriptions stated on PS Form 3541 (include paid distribution above nominal rate, advertiser's proof copies, and exchange copies): average number of copies each issue during preceding 12 months, 0; number of copies of single issue published nearest to filing date, 0. (*3*) Paid distribution outside the mails including sales through dealers and carriers, street vendors, counter sales and other paid distribution outside USPS: average number of copies each issue during preceding 12 months, 74,465; number of copies of single issue published nearest to filing date, 75,181. 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I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties). Signature and title of Editor, Publisher, Business Manager, or Owner: (signed) Michael Florek, Vice President and General Manager. Date: October 1, 2009.

COURTESY OF MICHAEL RUGG; COURTESY OF MARK A. W. ANDREWS

Head Games

Match wits with the Mensa puzzlers

1 GEOMETRIC MATCH

These three triangles are made of three matchsticks apiece. Rearrange the matchsticks to make five triangles, using only the nine matchsticks shown and moving only three of the matchsticks.

2 CRYPTOGRAM

Crack the code to complete the sentence. (Hint: Our updated version doesn't rhyme, but it does make a comment.)

Old Mother Hubbard went to the cupboard, to get her poor dog a bone. When she got there,

RGD QDZC SGD KZADK ZMC ENTMC ZKK ZQSHEHBHZK HMFQDCHDMSR RN RGD RGZQDC GDQ RSDZJ

3 IN A DAYS

A restaurant owner was going to close up shop while he went on vacation. Because he was a puzzle fiend, he left the following note on the door: "Today is Wednesday, July 1. We shall be closed for vacation from the day after two days before the day after tomorrow." What day of the week did the restaurant close for vacation?

4 WORD MAZE

The beautiful new tablecloth was Mother's pride and joy, but the children insisted on dropping their books on the table—and the cloth—when they came in from school each day. Mother put up a sign to warn them off. To find out what her message said, trace a path through this block of letters that touches each letter once and only once. You can start at any letter and move in any direction (including diagonally), but the path cannot cross itself.

T	O	O	E	C
N	A	M	H	L
Y	B	O	T	O
S	K	O	L	T
S	P	O	I	H

5 SEAMS IN SECONDS

If 3 sewers can sew 3 seams in 7 seconds, how many seams can 6 sewers sew in 70 seconds?

6 WORD SQUARE

A word square is a block of letters that form the same words when read in horizontal rows or vertical columns. For example, here is a 3-letter word square beginning with "saw":

S	A	W
A	W	E
W	E	T

Make a 5-letter word square beginning with "brush." (There is more than one possible answer. The square we have in mind has 5 Es; 4 Rs; 3 each of M and O; 4 Ss; and 2 each of B, U and H.)

B	R	U	S	H
R				
U				
S				
H				

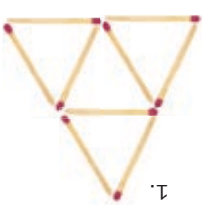
7 TRICKY TIMES TABLE

The following multiplication problem uses each number from 0 to 9 once and only once. Three numbers have been filled in to get you started.

```
  2??
 ×?4
-----
??0??
```

Answers

1.



2. She read the label and found all artificial ingredients so she shared her steak. (Each letter represents the letter following it in the alphabet: R = S.)

3. Thursday.

4. Too many books spoil the cloth.

5. 60 seams

6. One possible solution is:

B	R	U	S	H
R	O	M	E	O
U	M	B	E	R
S	E	E	M	S
H	O	R	S	E

7.
```
  297
× 54
------
16,038
```

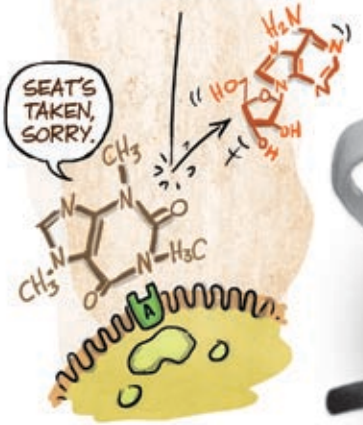
How much is TOO MUCH COFFEE?

By Dwayne Godwin & Jorge Cham

LEGEND HOLDS THAT "KAFFA," OR COFFEE, WAS DISCOVERED IN WESTERN ETHIOPIA BY A MAN WHO ONE DAY NOTICED HIS GOATS WERE MORE ACTIVE AFTER EATING COFFEE BEANS.

TODAY CAFFEINE IS THE MOST WIDELY USED BRAIN STIMULANT IN THE WORLD.

CAFFEINE WORKS BY BLOCKING ANOTHER CHEMICAL IN YOUR BRAIN CALLED ADENOSINE FROM BONDING TO RECEPTORS ON YOUR NEURONS.



ADENOSINE IS AN INHIBITOR THAT KEEPS IN CHECK MANY BRAIN REGIONS, INCLUDING ONE CALLED THE RETICULAR ACTIVATING SYSTEM, WHICH BASICALLY AMPLIFIES BRAIN ACTIVITY.

WHEN ADENOSINE IS BLOCKED, THIS REGION GOES INTO OVERDRIVE, SENDING A WAKE-UP CALL TO THE REST OF YOUR BRAIN.

IS CAFFEINE ADDICTIVE? SOME SCIENTISTS THINK SO.

BUT IT'S NOT AS BAD AS OTHER DRUGS, BECAUSE IT DOESN'T STRONGLY AFFECT THE DOPAMINE PATHWAYS RELATED TO ADDICTION.

YOUR BRAIN DOES LEARN TO BALANCE THE CAFFEINE, THOUGH, WHICH IS WHY STOPPING COLD CAN BE A REAL HEADACHE.

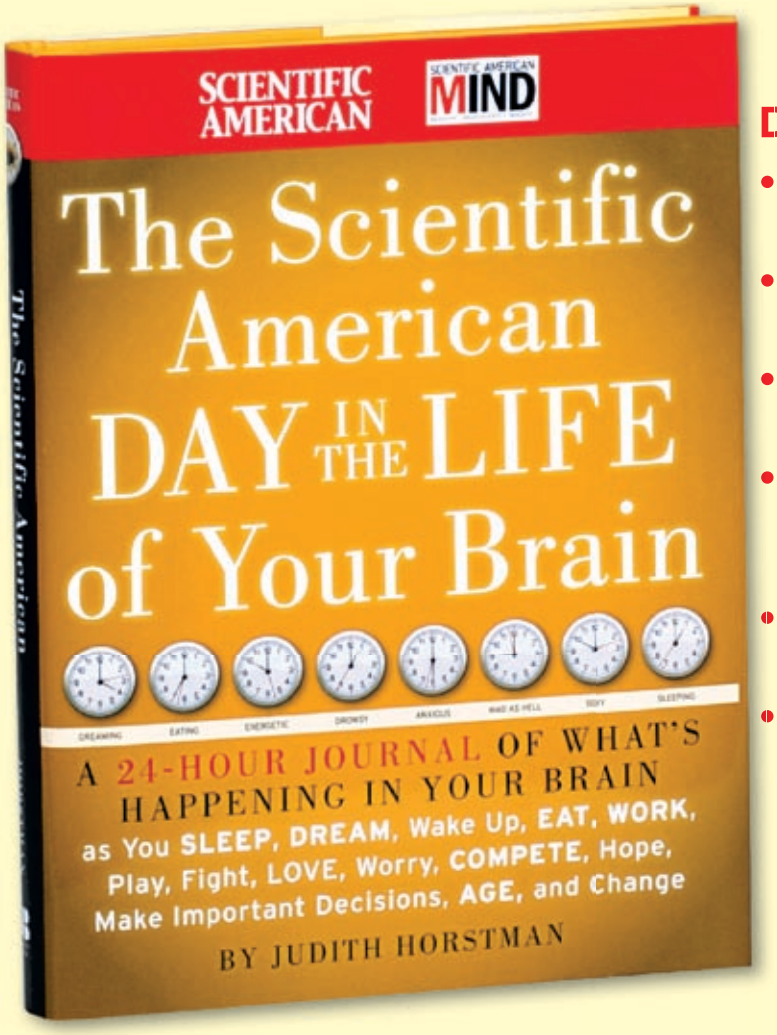
AND WHILE THE EQUIVALENT OF 100 CUPS OF COFFEE CAN KILL YOU...

...STUDIES HAVE FOUND THAT IN MODERATION IT MAY HELP PROTECT AGAINST ALZHEIMER'S AND PARKINSON'S DISEASE.

PERHAPS OUR CRAVING FOR COFFEE ISN'T ALL THAT

Dwayne Godwin is a neuroscientist at the Wake Forest University School of Medicine. Jorge Cham draws the comic strip "Piled Higher and Deeper" at www.phdcomics.com

Your brain at work and play.



Did you know that:

- Your brain occupies 2% of your body but uses 20% of your energy.
- Stress shrinks your brain. Exercise strengthens it.
- Just smelling coffee can make you more alert.
- You're most likely to have a heart attack in the morning—and to commit suicide in the evening.
- Dancing the tango helps Parkinson's patients.
- Sex, drugs, and rock and roll all stimulate the same brain areas. (Yes, science proves your parents were right.)

"A breezy, fact-filled, and eye-opening journey through the neural machinery that navigates us through every moment."

—**Daniel Goleman**, bestselling author, *Emotional Intelligence*

"A fabulous accomplishment. It is practical, fun, easy to read, and filled with interesting, useful information."

—**Daniel G. Amen, M.D.**, bestselling author, *Change Your Brain, Change Your Life*

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