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Nice Guys Finish First

Sleepwalking Killers

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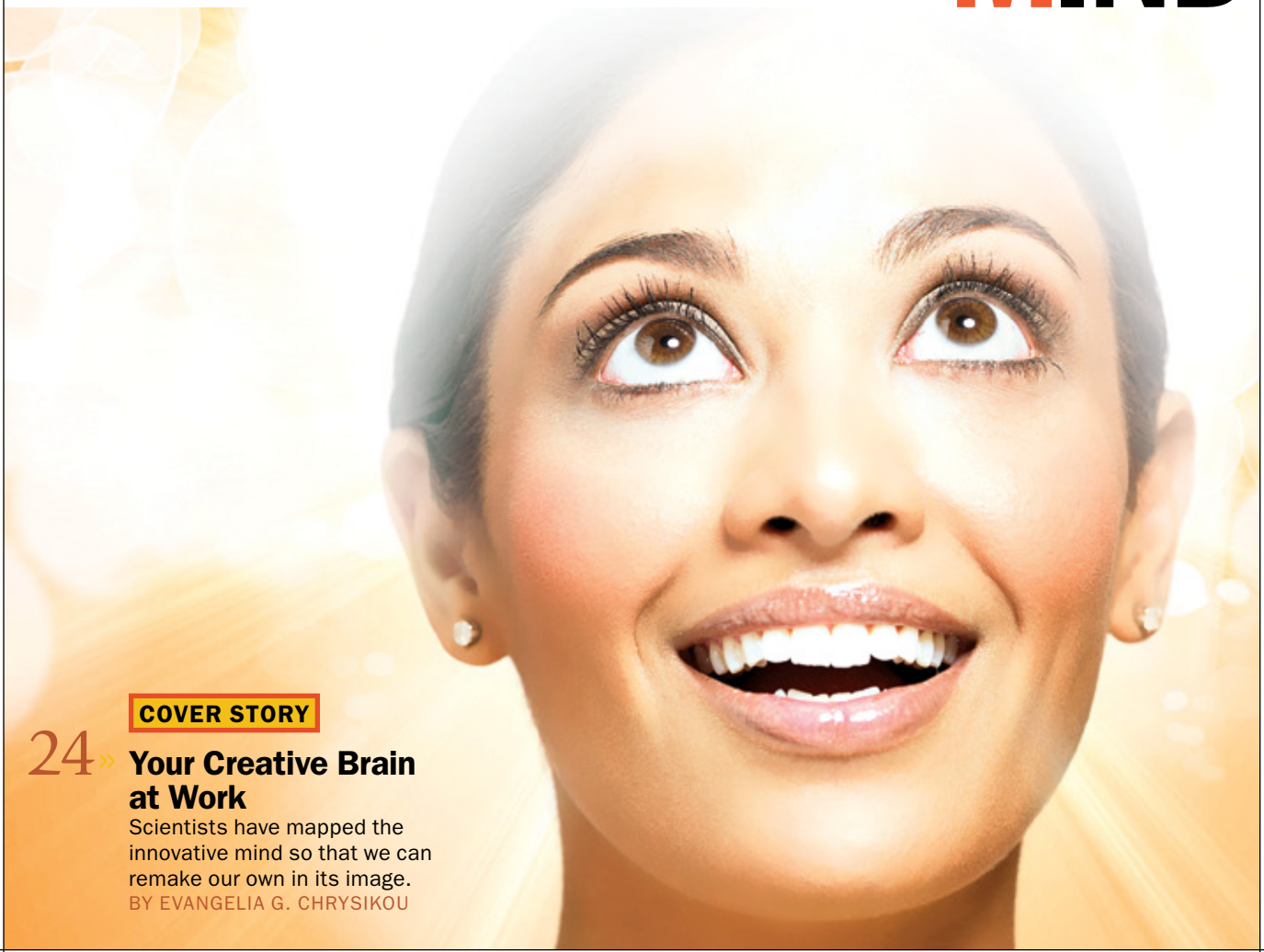
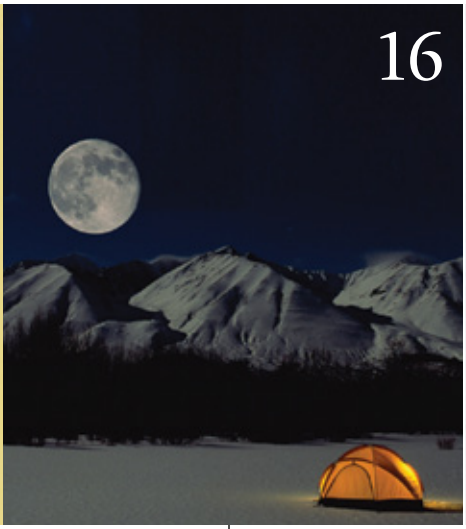
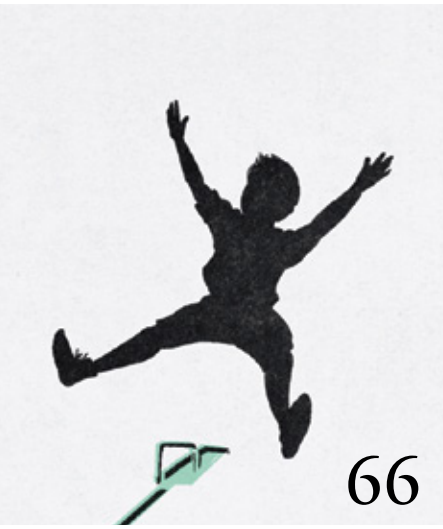
SCIENTIFIC AMERICAN MIND
Volume 23, Number 3, July/August 2012



FEATURES

DEPARTMENTS





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Get Creative

My old apartment in New York City had seen better days. Stains had darkened the carpet by several shades, and gusts of wind would blow crumbs of decaying brick from the walls. But those details were easily overshadowed by the glaring health code violation that was the bathroom.

The ceiling had sprung a leak directly over the toilet. Whenever the upstairs neighbors took a shower, dirty water came down in a robust pitter-patter; other times a light drizzle descended. Nature calls whenever she chooses, however, and one day I needed relief during a bathroom downpour. So I threw on my rain slicker, opened my umbrella and charged in. After that day—and until the ceiling was fixed—I kept an umbrella hanging on the towel rack.

My modest innovation, spawned by desperation, does not come close to the blazing insight that led to the creation of Amazon, the iPhone or wrinkle-free pants. Yet psychologist Evangelia G. Chrysikou tells us we can find inspiration by dropping our internal filters and rethinking the uses of everyday objects. Turn to "Your Creative Brain at Work," on page 24, to garner more tips.

With your brain buzzing with ideas, collect your next performance boost from an unexpected source—simply being kind. In "When Nice Guys Finish First," on page 62, psychologist Daisy Grewal explains that being a good egg helps you gain allies at work and, more important, lets you enjoy life more than the curmudgeons do. (Not that these nice folks would ever gloat about it.)

Even the grim reaper can hoist us closer to mental magnificence. In "Mortal Thoughts," on page 54, psychologist Michael W. Wiederman explores how acknowledging our inevitable demise can shift our personal values from material goals to idealistic pursuits, encouraging us to focus on the facets of life that are most rewarding.

Abandoning material concerns—such as the desire for a functional bathroom—was a winning strategy for me. In short, I moved. May you also find simple tweaks that allow your mind to soar to creative heights.

Sandra Upson
Managing Editor
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A CHEMICAL RED FLAG

Regarding "How Packaged Food Makes Girls Hyper," by Aimee Cunningham [Head Lines], it is possible that a high level of BPA in the mother is a symptom of a different underlying problem, rather than the cause of the behavioral issues in young children.

The sources of BPA in humans are commonly packaging from processed foods and beverages that may themselves contain many other additives. High BPA levels probably correlate with poor diet and nutrition, as well as with higher levels of caffeine, artificial sweeteners, colors and flavors, all of which some studies link causally with behavioral problems in children.

Parents with poor social support or less education may resort to these kinds of foods more often, and thus it may be that disadvantage, social isolation or parental neglect is responsible for some of the three-year-old girls who were "more anxious, depressed and hyperactive" and who had "more difficulty … controlling their emotions and inhibiting behaviors."

That said, it is self-evident that endocrine disruptors and chemicals that mimic hormones—such as BPA—might have dramatic effects on fetal development and subsequent behavior in childhood and on the timing of puberty.

"Dr Jane"
commenting at
www.ScientificAmerican.com/Mind

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MEAT EATERS' MORALITY

"The Carnivore's Dilemma," by Morgen E. Peck [Head Lines], showed that there was some difference among the mind-sets of people who knew they were about to eat meat as compared with people who were about to eat a nonmeat snack.

Personally, I think this is a beneficial adaptation because any reservations about eating anything, especially something as nutritious as meat, would put a lot of negative selection pressure on the individual harboring these feelings. Basically, because even our closest ancestors are mostly vegetarian, anybody in the *Homo* genus that was grossed out by meat had a much lower probability of passing on their genes.

Because most Americans eat too much meat anyway, it would help a lot if people gave more thought to how much land, water, food, energy and other resources were used and to the sacrifices made by the animal that provided the meat they are eating before going overboard with their meat consumption. If these facts were more present in people's minds, wasting meat would be less of a problem.

"sault"
commenting at
www.ScientificAmerican.com/Mind

PREGNANCY BRAIN

I wonder why "The Problem with the Pill," by Janelle Weaver [Head Lines], did not mention the fact that the pill changes the hormonal body balance into a virtual "pregnancy" mode, which in turn can change a woman's mood into moodiness (as I can attest from past personal experience).

Many studies have also shown that, with prolonged use of the pill, there is a definite loss of libido as a side


(we're only human)

The Nuts and Bolts of Emotional Sobriety

effect to be taken into account. These effects could explain the study's findings; for instance, that pill users think their mates are less sexually attractive.

"sunnystrobe"
commenting at
www.ScientificAmerican.com/Mind

EMOTIONS IN ADDICTION

"The Nuts and Bolts of Emotional Sobriety," by Wray Herbert [We're Only Human], reminded me of my own experience.

As a kid, I was taught that it was inappropriate to show feelings. I incorporated the belief that it was also inappropriate to have feelings. I was in counseling briefly when I was 25 or so, and when the counselor asked me, "How do you feel about that?" I had absolutely no concept of what she was talking about.

Many years later, trying to get sober, I began to learn what feelings were, how to identify them and, most important, what to tuck away for later and what to deal with now—as this article describes. I learned that feelings, although they may hurt, cannot harm me unless I let them. I remember well the very first time that I felt joy and was able to identify and enjoy it. Wow!

I learned all the techniques in this article and put them into practice with a good deal of success. It's been a really good life for the past 40 years. Moreover, I learned it all in Alcoholics Anonymous (AA), long before the days of formal credentialing for addictions counseling and cognitive-behavior therapy.

It still amazes me that these pioneers in recovery were so insightful and so far ahead of their time. Maybe they did not have the science, but it is clear to many of us that they damn well knew how to get sober and recover.

As former head of the Chemical Dependency Counselor program at Suffolk Community College on Long Island, I think the formal study of addiction and the practice of counseling have come a very long way since then, but in some ways not all that much has really changed. We will always owe a lot to the founders of AA.

"cccambell38"
commenting at
www.ScientificAmerican.com/Mind

MARIJUANA'S EFFECTS

"The Truth about Pot," by Hal Arkowitz and Scott O. Lilienfeld [Facts and Fictions in Mental Health], is a good article that goes over many of the issues surrounding marijuana. But I don't think that we as a society are talking about the most important issue. When people use alcohol, a drug that we have a lot of information about, we have legal guidelines concerning how intoxicated a user is. We have test equipment, and police officers are trained to use it to keep the public safe from abusers. The problem with marijuana is that it is very difficult to know how intoxicated or affected someone is who smokes pot. There is no rating system concerning the potency of the drug, and the residual effects can last for days. When a train engineer crashes his locomotive into an oncoming passenger train, are we able to say how much his use of marijuana two days prior to the accident affected his performance?

Until these types of issues are resolved, public sentiment concerning the moral nature or medical efficacy of the drug is irrelevant.

"LongbowMike"
commenting at
www.ScientificAmerican.com/Mind

As a marriage counselor, I've had lots of clients over the years who were addicted to pot. One thing that I find always missing from these drug studies is the effect of drug use or abuse on relationships. I would guess that about half the couples I see for counseling are experiencing adverse impacts of drugs and alcohol on their marriage.

Many times the chronic pot user seems to have *puer eternis*, or arrested development, and still relates to the world like a teenager.

"pabloson"
commenting at
www.ScientificAmerican.com/Mind

DAVID SENIOR

>> MUSIC

Meaning in Melody

Emotions in music mimic the way we emote in speech

A haunting melody can change your mood in just a few notes. New evidence suggests it is the distance between notes that determines how they make us feel—and that characteristic may have evolved from the way we use our voice.

Daniel Bowling, a cognitive neuroscientist at Duke University, analyzed the intervals, or distances between notes, in melodies from Western classical music and Indian ragas in a study published in March in *PLoS ONE*. He found that in both types of music, the size of the average interval is smaller in melodies associated with sadness and larger in melodies linked with happiness. Consider Beethoven's *Moonlight Sonata.* The melody in the first movement sways mournfully in a small grove of notes. In the second, happier movement, the melody takes off, lightly skipping through a much broader swath of the scale.

Bowling suggests that music mimics the natural patterns of our most primitive instrument—the voice. To test his theory, he collected speech samples from 20 English speakers and 20 Tamil Indian speakers and looked at whether the changes in frequency predicted the emotional content of their words. He found the same pattern as he did in written melodies: the sadder the speech, the more monotone the delivery. "Through the voice, we've come to associate different emotions with different tonal characteristics," Bowling says. —*Morgen E. Peck*

>> EATING

Tired? Watch What You Eat

How losing sleep gives your brain the munchies

One of the strangest findings to emerge from the world of obesity science lately is that people who sleep less tend to weigh more. But until recently, we have been stifling our yawns and scratching our heads about why: Does lack of sleep alter our biology? Or does it affect our eating behavior? Now two brain-imaging reports suggest the answer is both.

The first study, published in March in the *Journal of Clinical Endocrinology & Metabolism*, looked at the effects of one night of no sleep. The second, published in April in the *American Journal of Clinical Nutrition*, tested the impact of nearly a week of more commonly experienced levels of sleep deprivation (four hours of sleep for six nights).

Both studies used functional MRI to measure brain activation as their subjects viewed food pictures—analogous to being bombarded with a stream of McMuffin ads after a long night of working (or partying). Each study discovered that sleep loss caused areas within a key motivation network, including the striatum and anterior cingulate cortex, to go into overdrive at the mere sight of food. The same circuit perks up when addicts view images of their substance of choice.

"Calories are energy, and your brain subconsciously knows they will wake you up," says Marie-Pierre St-Onge of Columbia University, lead investigator of the April study. She likens the superresponsive sleep-poor brain to that of someone who has lost weight on a drastic diet—devouring the first snack you can get your hands on is a "no-brainer."

Scientists do not fully understand how sleep loss affects the machinery of neural motivation. Past studies have established that the stress of sleep deprivation puts the autonomic nervous system on alert, leading to increases in the hunger hormone ghrelin and decreases in the satiety hormone leptin. These changes may be detected by the brain's motivation circuits—which respond by keeping an eye out for doughnuts.

Christian Benedict, a neuroscientist at Uppsala University in Sweden who co-led the March study, is also exploring whether sleep restriction could interfere with the way our brain perceives the taste of high-calorie foods.

Whatever the underlying biology, it seems that skimping on sleep could well make us hungry as well as irritable. So if you're watching your waistline and feeling snoozy, it's probably wise to avoid the breakfast buffet until you get a chance to nap.

—Susan Carnell

DAN KENYON Getty Images (*left*); ISTOCKPHOTO (*right*)

>> EMOTIONS

Why We Love Sad Movies

Tearjerkers make us count our blessings

After watching a sad movie, people are happier about their own life, researchers at the Ohio State University report online in March in *Communication Research*. Almost 400 undergraduates (211 women, 150 men) viewed a segment of *Atonement*. Before and after the film the students completed a survey about happiness in their life and relationships. The participants felt happier afterward, the researchers found, because they reflected on their own relationships and thought about how much their loved ones enhanced their life—in effect, counting their blessings—not because they concluded that their life was better than those depicted in the film. ***—Harvey Black***

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>> HEAD COUNT

Average number of additional calories sleep-deprived people eat every day as compared with well-rested individuals, new research shows.

>> CHILD DEVELOPMENT

Why Sharing Is Tough for Tots

An underdeveloped prefrontal cortex makes sharing difficult for young children

If a child you know refuses to share his toys, chances are he knows he is doing wrong but cannot help it. New research published in March in *Neuron* reveals that underdevelopment of an impulse control center in the brain is, at least in part, the reason children who fully understand the concept of fairness fail to act accordingly.

As babies, we are inherently selfish, but as we grow, we become better at social strategy—that is, satisfying our own needs while behaving in a manner acceptable to others. Nikolaus Steinbeis of the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, Germany, wondered how this skill develops.

Steinbeis and his team examined kids aged six to 14 performing two similar decision-making tasks that involved sharing poker chips with an anonymous recipient (the chips were redeemable for prizes). In task one, the size of a child's offering carried no consequences, but in the second task, the anonymous youngster could reject the offer, if he or she considered it unfair, and both children would get nothing. Task two thus required social strategy; task one did not.

In task one, older and younger children behaved similarly. But in task two, younger children both made worse offers and were more willing to accept bad offers even though they understood that these offers were unfair. Imaging the kids' brains while they performed the tasks revealed less activity in the younger kids' impulse-control regions in their prefrontal cortex, the seat of decision making and self-control in the brain. In addition, independent of age, less activity in this region paralleled less social strategy.

So if a kid has trouble playing fair, it is probably not because he does not understand the concept. Rather he simply cannot resist the urge to grab all the cookies and run. Steinbeis points out, however, that this finding does not excuse bad behavior. "Just because the brain is that way doesn't mean it can't be changed," he says. "Education and setting a good example can have an enormous impact." —*Ruth Williams*

>> CREATIVITY

Rename It, Reuse It

Thinking generically leads to innovative uses for everyday items

To become more inventive, new research suggests, we should start thinking about common items in terms of their component parts, decoupling their names from their uses.

When we think of an object—a candle, say—we tend to think of its name, appearance and purpose all at once. We have expectations about how the candle works and what we can do with it. Psychologists call this rigid thinking "functional fixedness."

Tony McCaffrey, a postdoctoral researcher at the University of Massachusetts Amherst, developed a two-step "generic parts technique," which trains people to overcome functional fixedness. First, break down the items at hand into their basic parts, then name each part in a way that does not imply meaning. Using his technique, a candle becomes wax and string. Seeing the wick as a string is key: calling it a "wick" implies that its use is to be lit, but calling it a "string" opens up new possibilities.

Imagine a bicycle as a collection of parts: chains, metal bars, tubes, and so on. One of these pieces might be just the tool you need.

Subjects he trained in this technique readily mastered it and solved 67 percent more problems requiring creative insight than subjects who did not learn the technique, according to his study published in March in *Psychological Science*. For instance, when given metal rings and a candle and asked to connect the rings together, those who named the candle's generic parts realized the wick could be used to tie up the rings. Another problem asked subjects to build a simple circuit board with a terminal, wires and a screwdriver—but the wires were too short. Those who renamed the shaft of the screwdriver a "four-inch length of metal" realized it could be used to bridge the gap and conduct electricity.

McCaffrey has used his generic-parts technique to help engineers solve real-world industrial problems, and he is adapting it into a software program for professionals who need creative insight at work. But he also says the technique has been particularly useful in his everyday life. He noticed the back of a yard chair was a piece of sturdy, curved plastic, and he used it to shovel piles of leaves. He also realized he could use binder clips to secure a leaning sapling to the edge of his gutter. "Ask yourself the question: Does my description of the part imply a use?" McCaffrey explains. Remove "binder" from the description, and the "clip" suddenly seems limitless. [For more on this study and others about creativity, see page 24.] —*Amy Mayer*

CORBIS (*top*); PHILIP GATWARD *Getty Images* (*bottom*)

>> REALLY?

Your brain can feel pain. The brain has no receptors for pain. Pain, including a headache, results from pressure on nerve tissue or blood vessels surrounding the brain.

>> IDENTITY

Be Your Own Best Friend

Research shows how to reap the benefits of self-compassion

GROVE PASHLEY Getty Images

Being kind to yourself is a surefire way to improve your mental health and reach your goals, a growing body of work suggests. Now research has revealed an easy way to boost this self-compassion—by showing kindness to others.

Self-compassion is distinct from self-esteem, a trait that can shade into narcissism. Nor should it be confused with self-pity or self-indulgence. "Self-compassion is treating yourself with the same kindness and care you'd treat a friend," says Kristin Neff, a professor of psychology at the University of Texas at Austin and the leading researcher in the growing field of self-compassion. People who are self-compassionate avoid harsh critiques or negative generalizations of themselves, and they see their troubles as part of the human condition.

Research is showing that this gentle, nonjudgmental approach helps individuals bounce back even after major crises. For example, in a study in press at *Psychological Science,* scientists found that newly divorced people who spoke compassionately toward themselves adjusted significantly better in the following 10 months than those who spoke more harshly, with self-compassion outperforming self-esteem and even optimism as a predictor of good coping.

Contrary to what many people think, treating yourself kindly is also good for achieving your goals. "People believe that self-criticism helps to motivate them," Neff says. Those low in self-compassion think that unless they are hard on themselves, they will not amount to much—but research reveals that being kind to yourself does not lower your standards. "With self-compassion, you reach just as high, but if you don't reach your goals it's okay because your sense of self-worth isn't contingent on success," she explains.

All of that is good news for the naturally self-compassionate, but what about the half of the population who tend to beat themselves up? Luckily, mounting research shows that you can cultivate your self-compassion through meditation and even simpler techniques. For example, pressing your hand against your heart or hiding this gesture in "a surreptitious hug" can give your self-compassion a momentary boost, Neff says.

A recent study at the University of California, Berkeley, suggests an even more surprising way to heighten self-compassion: acting compassionately toward others. In a presentation in January at the Society for Personality and Social Psychology conference, researchers Juliana Breines and Serena Chen described a set of experiments in which they asked one group of participants to give support to another person, such as writing down suggestions to make a friend feel better after causing a fender bender. Those in the support-giving condition went on to rate themselves higher in compassion for themselves than did participants who had been asked either to recall a fun time with a friend or to merely read about the suffering of others.

"There was a unique benefit to giving support—the benefit wasn't just from feeling connected or realizing that others had problems, too," explains Breines, a doctoral candidate in psychology and the study's lead author. During tough times, people naturally tend to focus on themselves and find it difficult to support others, she says. "But actually, as many people intuitively discover, taking the opportunity to support other people can make you feel better about what you're going through."

—Marina Krakovsky

>> ATTACHMENT

Close Bonds Increase Novelty's Appeal

Thinking about a close, happy relationship gives people the energy to explore

Psychologists know that "secure attachments"—close, positive relationships such as healthy marriages and good friendships—increase our interest in new experiences. Babies who have learned they can count on their moms, for example, tend to try unfamiliar toys in a lab more readily than do babies whose insecure attachment to caregivers makes them anxious and clingy. A recent set of studies published in *Personality and Social Psychology Bulletin* reveals a surprising explanation for this attachment-exploration link: feeling alive and full of energy.

Research participants who recalled a close positive relationship from their lives were later more willing to opt for novel activities like foreign travel—and to report heightened vitality—than participants who had thought about a negative relationship or even a sitcom character. "In insecure relationships, people have to resolve negative emotions because their needs haven't been met, and having to do that can be emotionally draining," explains lead author Michelle Luke of the University of Southampton in England.

That energy drain leaves you with low vitality; exploring unfamiliar territory feels like it would be overwhelming. Thinking about a good relationship, on the other hand, may give you an energy boost for trying new things. —*Marina Krakovsky*

1,000

Number of genes scientists estimate are involved in brain function.

>> NEUROSCIENCE

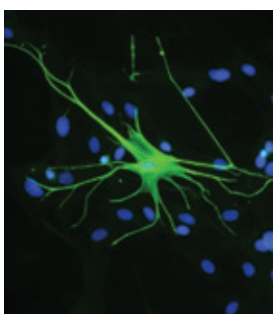
What Marijuana Reveals about Memory

Glial cells, not neurons, are responsible for marijuana-induced forgetfulness

Until recently, most scientists believed that neurons were the all-important brain cells controlling mental functions and that the surrounding glial cells were little more than neuron supporters and "glue." Now research published in March in *Cell* reveals that astrocytes, a type of glia, have a principal role in working memory. And the scientists made the discovery by getting mice stoned.

Marijuana impairs working memory—the short-term memory we use to hold on to and process thoughts. Think of the classic stoner who, midsentence, forgets the point he was making. Although such stupor might give recreational users the giggles, people using the drug for medical reasons might prefer to maintain their cognitive capacity.

To study how marijuana impairs working memory, Giovanni Marsicano of the University of Bordeaux in France and his colleagues removed cannabinoid receptors—proteins that respond to marijuana's psychoactive ingredient THC—from neurons in mice. These mice, it turned out, were just as forgetful as regular mice when given THC: they were equally poor at memorizing the position of a hidden platform in a water pool. When the receptors were removed from astrocytes, however, the mice could find the platform just fine while on THC.



An astrocyte in the brain.

The results suggest that the role of glia in mental activity has been overlooked. Although research in recent years has revealed that glia are implicated in many unconscious processes and diseases [see "The Hidden Brain," by R. Douglas Fields; SCIENTIFIC AMERICAN MIND, May/June 2011], this is one of the first studies to suggest that glia play a key role in conscious thought. "It's very likely that astrocytes have many more functions than we thought," Marsicano says. "Certainly their role in cognition is now being revealed."

Unlike THC's effect on memory, its pain-relieving property appears to work through neurons. In theory, therefore, it might be possible to design THC-type drugs that target neurons—but not glia—and offer pain relief without the forgetfulness. —*Ruth Williams*

RANDY FARIS *Corbis (top)*; RICCARDO CASSIANI-INGONI *Photo Researchers, Inc. (bottom)*

>> EMBODIED COGNITION

Right Hand, Right Choice

Why we are biased toward things on our dominant side

If you are right-handed, chances are you will make different choices than your left-handed friends. A series of recent studies shows that we associate our dominant side with good and our nondominant side with bad, preferring products and people that happen to be on our "good" side over those closer to the other half of our body.

The theory of embodied cognition, widely embraced by cognitive scientists in recent years, holds that our abstract ideas are grounded in our physical experiences in the world. (See above: "embraced," "holds," "grounded.") Daniel Casasanto, a psychologist at the New School for Social Research, began to wonder: If our bodies shape our thinking, do people with different bodies think differently? He has been using handedness as a test bed for this body-specific hypothesis.

In a set of studies published in 2009 Casasanto found that right-handers associate right with good and left with bad and that left-handers make the reverse associations. People prefer objects, job candidates and images of alien creatures on their dominant side to those on their nondominant side. In 2010 he reported that presidential candidates (Kerry, Bush, Obama and McCain) gesture with their dominant hands when making positive points and their weak hands to emphasize darker matters. And he has collected data to suggest that lefties hold higher opinions of their flight attendants when seated on the right side of a plane.

To rule out the possibility that this bias is purely genetic, like handedness is, Casasanto handicapped people's preferred hands. In a 2011 study he had subjects manipulate dominoes while wearing a bulky ski glove on their good hand. Afterward, they showed a bias against things on that side. The results suggest that we look kindly on half the world because we can interact with that side fluently. Make it a hassle, and opinions flip.

Most recently, Casasanto reported in January in *Cognitive Science* that children as young as six display a handedness bias. Kids were asked which animal in a series of cartoon pairs looked nicer or smarter. The right-handers more often chose the drawing on the right side, and the left-handers more often chose the animal on the left. They also elected to put away their preferred toys in boxes on their dominant side.

"We all walk around with these lopsided bodies and have to interact with our environment in systematically different ways," Casasanto notes. Given how broadly those interactions can influence our thinking, he says, "body specificity may be shaping our judgments in the real world in ways that we never suspected." —*Matthew Hutson*

30

PERCENT OF PEOPLE AGED 18 TO 25 WHO REPORTED HAVING A MENTAL DISORDER IN 2010, THE HIGHEST OF ANY AGE GROUP,

ACCORDING TO A SURVEY BY THE SUBSTANCE ABUSE AND MENTAL HEALTH SERVICES ADMINISTRATION.

>> AGING

The Mental Pause of Menopause

Trouble with focus and memory lapses are not just in a woman's head

Menopause brings many changes: hot flashes, changes in libido, and, according to some women, difficulties with memory and concentration. A new study in the journal *Menopause* shows that the mental fog reported by many menopausal women is very real. Researchers gave a battery of cognitive tests to 75 menopausal women and asked them how menopause had affected their thinking. Nearly half of them reported "serious" forgetfulness in the study, and the women who described the most problems with concentration and memory also scored worse on the cognitive tests. The investigators hope the finding that mental effects are not just being imagined by menopausal women, as some physicians have believed, will spur research on treatments. ***—Carrie Arnold***

GETTY IMAGES (*top*); BARBARA PENOYAR *Getty Images* (*bottom*)

>> HUMOR

Joking the Pain Away

Positive humor improves mood more than negative humor

An amiable joke can be much more effective than darker humor at improving mood, according to recent research from Stanford University.

In the study, led by psychologist Andrea Samson and James Gross and published in February in *Cognition & Emotion*, 40 people in Switzerland and 37 people in the U.S. looked at photographs of upsetting things such as car accidents, corpses and dangerous animals. They were instructed to either say nothing about the images, use good-natured humor focusing on the absurdity of life or the human condition, or use mean-spirited humor. The experimenters offered examples of each type of response to help coach the subjects; given a picture of a snake with its prey, for instance, "Looks like someone's bitten off more than they can chew" exhibits positive humor, whereas "Nourishing my future handbag" has a negative spin.

In both countries, those who made benevolent jokes about the images had more positive emotions and fewer negative emotions afterward than those who laughed mockingly at the pictures, although both groups who used humor fared better than those who simply looked silently.

The upshot: when something upsets you, humor can help. The next time you try to laugh off a grim situation, reflect on whether your jokes skew negative ("My boss isn't just dumb; he has terrible body odor, too!") or positive ("No matter what happens at work, I've got it better than a politician these days . . ."). You might find tweaking your comedic style could give more of a boost. —*Jessica Gross*

>> PSYCHOACTIVE DRUGS

Curing Addicts with Acid

A single dose of LSD might help curb alcohol abuse

Psychedelic drugs are making a quiet comeback, as a smattering of recent studies have demonstrated their medicinal potential. The latest finding suggests it is time to revisit LSD as a treatment for addiction.

Pål-Ørjan Johansen and Teri Krebs of the Norwegian University of Science and Technology analyzed six clinical trials of LSD from 1966 to 1970 and published their results in March in the *Journal of Psychopharmacology*. The study subjects were being treated for alcohol abuse at inpatient clinics. They all underwent the standard treatment regimen for addiction, but some of them were also given a single, small dose of LSD during a therapeutic session.

The results of the old studies were tepid, but they all hinted that LSD had helped. Pooling the data gave Johansen and Krebs more statistical power. "Instead of six small studies, you have one big study," Krebs says, and the results of that larger study were much more robust. Of those who had taken LSD, 59 percent decreased their alcohol consumption, as compared with 38 percent of subjects who did not take LSD. Six months after leaving treatment, those who took LSD were 15 percent more likely to be sober.

Illicit LSD is often taken via blotter paper.

For just one dose of a psychiatric drug to remain effective for months is an impressive feat that researchers attribute to the unique qualities of psychedelics such as LSD. The feelings of openness and well-being brought on by the drug seem to help people see themselves—and their problems—in a different light. In this way, LSD could act as a kind of chemical catalyst for the "moment of clarity" cited by many addicts as a turning point in their treatment.

Krebs and other researchers are quick to point out that context matters for LSD's therapeutic potential; dropping acid at home will probably not help cure addictions the way it might in a rehabilitation facility under psychiatric guidance. The results add to the growing body of work suggesting that psychedelics have untapped potential. For instance, doctors have had recent success using MDMA, the psychoactive substance in ecstasy, to treat posttraumatic stress disorder. Other research has found that psilocybin, the active ingredient in magic mushrooms, can ease anxiety in terminal cancer patients.

This recent spate of promising findings belies the hurdle researchers face: getting funding for such studies remains quite difficult, as it has been since the antidrug movement of the late 1970s. Yet Johansen thinks the tide may be turning. "People are definitely getting more interested," he says. "And I think that's going to make it easier to get grant money going forward."

—*Ian Chant*

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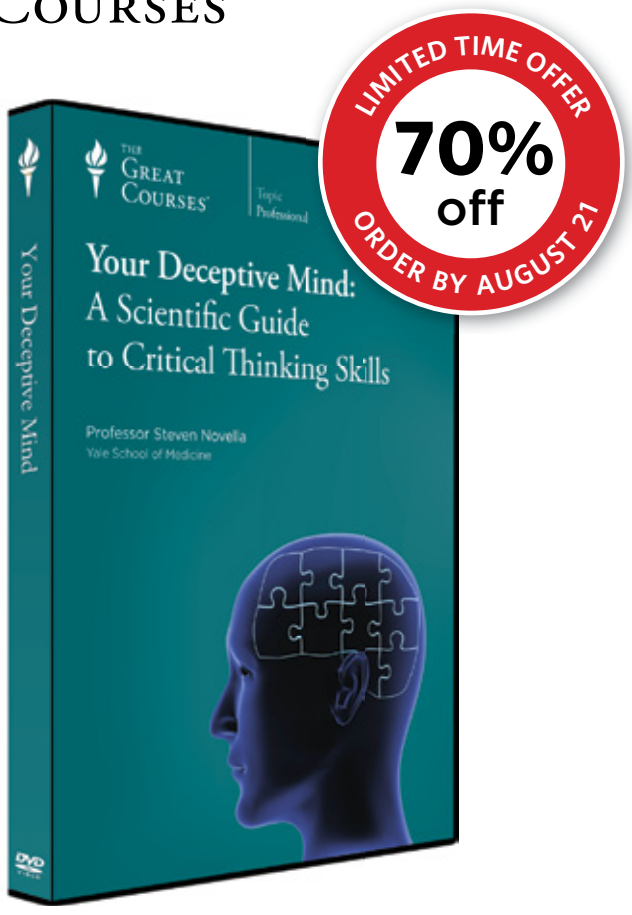

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DEVELOPMENTAL DISORDERS

Horses Soothe Kids with Autism

The animals' motion may correct rhythm coordination problems

Animals have helped many kids with autism improve their speech and social skills, but these cases have been largely isolated. Now the first scientific study of horse therapy finds its many benefits may have to do with rhythm.

A study of 42 children with autism, six to 16 years old, found that riding and grooming horses significantly bettered behavioral symptoms. Compared with kids who had participated in nonanimal therapy, those exposed to horses showed more improvement in social skills and motor skills, rated via standard behavioral assessment surveys, according to the study published in the February issue of *Research in Autism Spectrum Disorders.* Psychologist Robin Gabriels of the University of Colorado Denver, who led the study, speculates that the calming, rhythmic motion of the horses played a role.

Rhythmic coordination issues underlie all the symptoms of autism, including repetitive behaviors and difficulty communicating, comments Robert Isenhower, a researcher at Rutgers University who was not involved with the study. Using drumming games, Isenhower has found that children with autism struggle more than typically developing children to keep a beat. This impairment affects unconscious social behaviors that most of us take for granted, such as pausing after questions or walking in step with others. "I think the horse might serve as a surrogate motor system for individuals with autism," he says. *—Ajai Raj*

! Children who were exposed to high levels of the common insecticide chlorpyrifos in the womb had **abnormal development of the cerebral cortex,** as compared with kids with low exposure, a recent MRI study concluded.

SLEEP

Tired and Amped

The brain gets more active the longer it goes without sleep

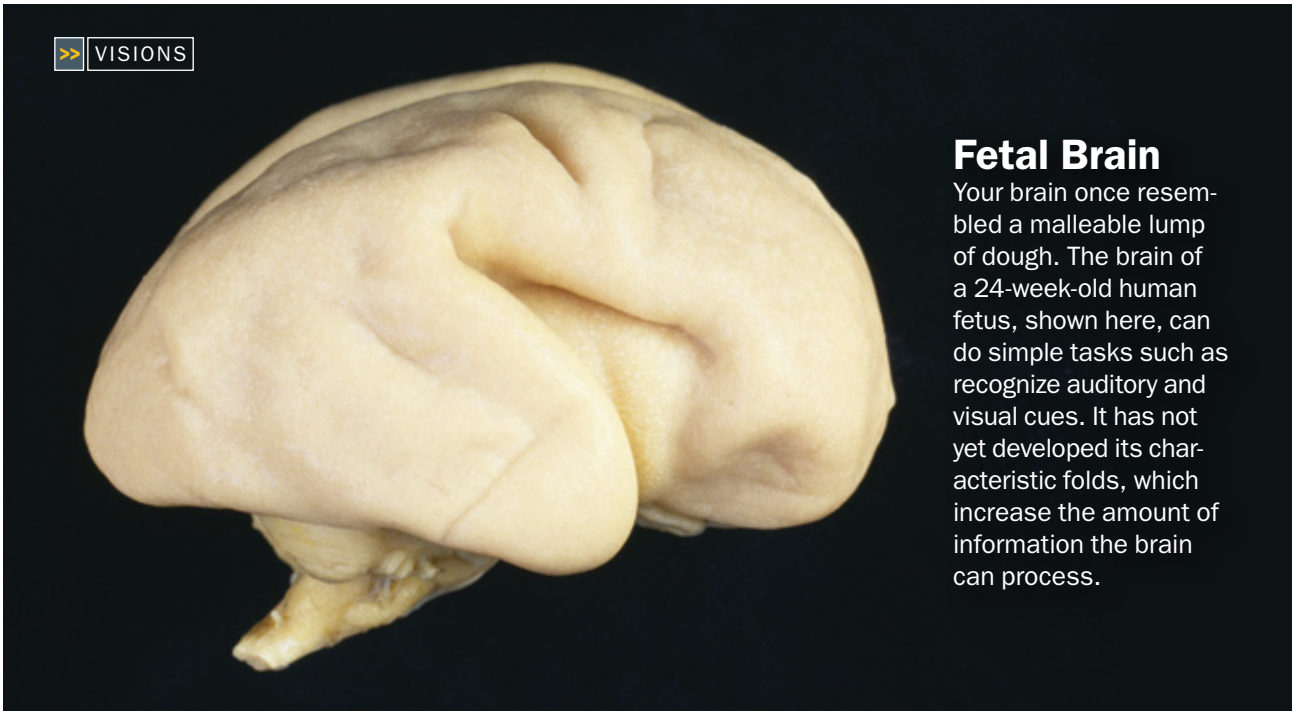
Anyone who has pulled an all-nighter knows it is possible to be tired without being sleepy. The body slows and concentration slips, even as thoughts spin toward a manic blur. It feels as though the sleep-deprived brain is actually becoming more active. And indeed it is, according to a recent study in the journal *Cerebral Cortex.*

Marcello Massimini, a neurophysiologist at the University of Milan in Italy, found that the brain becomes more sensitive as the day wears on. The experiment, he explains, is like poking a friend in the ribs to see how high he jumps. Massimini prodded brain cells in the frontal cortex with a jolt of electricity, delivered via noninvasive transcranial magnetic stimulation. Then he observed how the rest of the brain responded, comparing results from subjects who had been awake for two, eight, 12 or 32 hours. "I'm sure if you bump your friend when he's sleep-deprived, he's going to jump higher," he says. The sleep-deprived brain, it turns out, also gets jumpy, responding to the electrical jolt with stronger, more immediate spikes of activity.

The results jibe with a widely held theory that while we are awake, our neurons are constantly forming new synapses, or connections to other neurons, which ramps up the activity in our brain. Many of these connections are irrelevant, but the only way to prune them is by shutting down for a while. The theory explains why it is difficult to cram new information into a sleepy brain. But it also helps to explain some unusual medical observations: epileptics are more likely to have seizures the longer they stay awake, and severely depressed patients with abnormally low brain activity sometimes improve after skipping sleep. "You keep them awake for one night, and, incredibly, they get better," Massimini says.*—Morgen E. Peck*

GETTY IMAGES (*left*); DALY AND NEWTON *Getty Images* (*right*)

>> VISIONS



Fetal Brain

Your brain once resembled a malleable lump of dough. The brain of a 24-week-old human fetus, shown here, can do simple tasks such as recognize auditory and visual cues. It has not yet developed its characteristic folds, which increase the amount of information the brain can process.

G. MOSCOSO Photo Researchers, Inc. (top); MARC ASNIN Redux Pictures (bottom)

>> FOOD

More Trouble with Trans Fats

People who eat more hydrogenated oils are more aggressive

If you want to keep your cool, you might want to pass up those greasy wings and gooey dessert. A new study from the University of California, San Diego, suggests that people whose diets are higher in trans fats are more prone to aggression.

Trans fats, or hydrogenated oils, have made the news in recent years because studies have strongly linked them to heart disease and cancer, and some locales have passed laws restricting their use. They are still common, however, in restaurant food and many grocery items.

Beatrice Golomb, a physician and associate professor of medicine at U.C. San Diego, wondered if trans fats might affect behavior, after noting how they interact with a type of healthy fat. Past studies found that docosahexaenoic acid—or DHA, a long-chain omega-3 fatty acid—has a calming, antidepressant effect. Trans fats disrupt the chemical process that leads to the conversion of fatty acids into DHA, which led Golomb to suspect that trans fats might be linked to aggression.

Her study, which was published in March in *PLoS ONE,* involved 1,018 men and women older than 20 who filled out a food questionnaire and several other surveys that measure impatience, irritability and aggression. Even after considering other influences, Golomb's team found a strong link between the intake of trans fats and aggression. "Trans-fatty acids were a more consistent predictor of aggression than some traditional risk factors such as age, male sex, education and smoking," Golomb says.

The findings were consistent across both sexes and across all ages, ethnicities and socioeconomic groups.

Although the correlation was strong, the study does not prove that trans fats are causing the aggressive behavior. It is possible that naturally aggressive people tend to eat less healthy food. Or perhaps other ingredients found in processed foods, such as added sugars, are the real culprit. "We like to think we're in charge of our behaviors, but in fact there are many factors that influence us, food being one of them," Golomb says. —*Winnie Yu*

Orgasm

One surprising result for some women during exercise

All Deceptions Great and Small

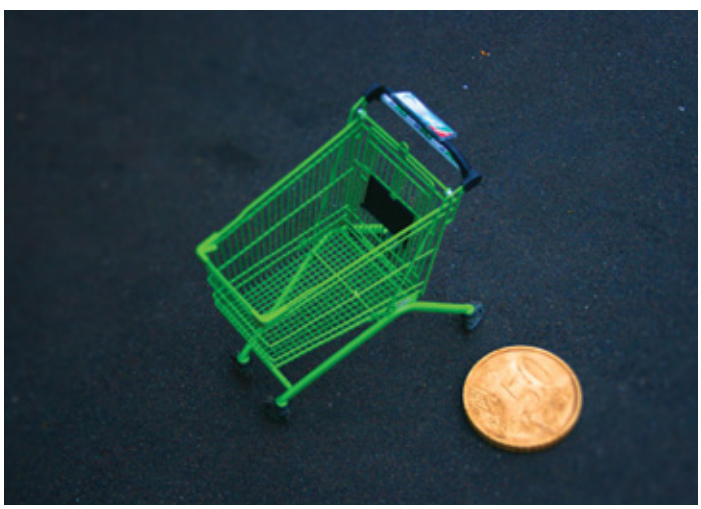
Does size matter? To your brain, it doesn't

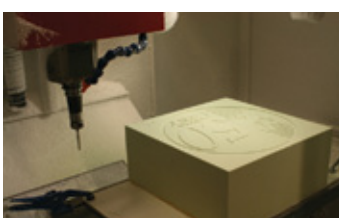
BY SUSANA MARTINEZ-CONDE AND STEPHEN L. MACKNIK

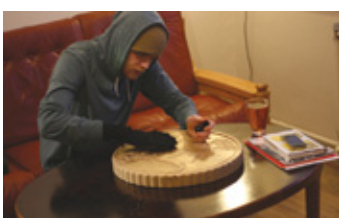
"Judge me by my size, do you? Size matters not."
—Yoda, Jedi master

AS BOTH the midget in the country of Brobdingnag and the giant on the island of Lilliput, Lemuel Gulliver—the protagonist of Jonathan Swift's *Gulliver's Travels*—experienced firsthand that size is relative. As we cast a neuroscientific light on this classic book, it seems clear to us that Swift, a satirist, essayist and poet, knew a few things about the mind, too. Absolute size is meaningless to our brain: we gauge size by context. The same medium-sized circle will appear smaller when surrounded by large circles and bigger when surrounded by tiny ones, a phenomenon discovered by German psychologist Hermann Ebbinghaus. Social and psychological context also causes us to misperceive size. Recent research shows that spiders appear larger to people who suffer from arachnophobia than to those who are unafraid of bugs and that men holding weapons seem taller and stronger than men who are holding tools. In this article, we present a collection of illusions that will expand your horizons and shrink your confidence in what is real. Try them out for size!

SUSANA MARTINEZ-CONDE and STEPHEN L. MACKNIK are laboratory directors at the Barrow Neurological Institute in Phoenix. They serve on *Scientific American Mind*'s board of advisers and are authors of *Sleights of Mind: What the Neuroscience of Magic Reveals about Our Everyday Deceptions,* with Sandra Blakeslee, now in paperback (http://sleightsofmind.com). Their forthcoming book, *Champions of Illusion,* will be published by Scientific American/Farrar, Straus and Giroux.







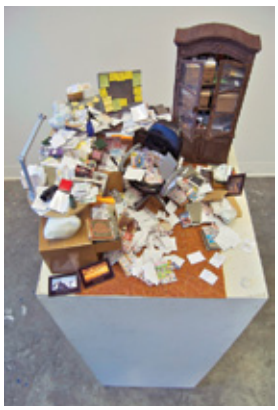
SMALL CHANGE

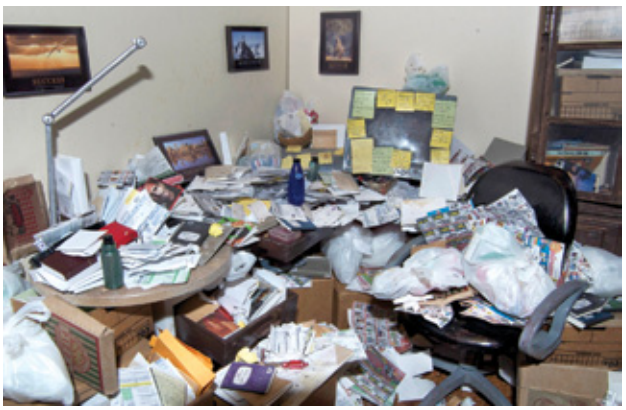
Do you see tiny objects photographed with a macro lens? Look again. This remarkable illusion combines tilt-shift photography—in which the photographer uses selective focus and a special lens or tilted shot angle to make regular objects look toy-sized—with the strategic placement of a giant coin. Art designers Theo Tveterås and Lars Marcus Vedeler, from the Skrekkøgle group, created the enormous 50-cent euro coin from painted and lacquered wood at a 20:1 scale.

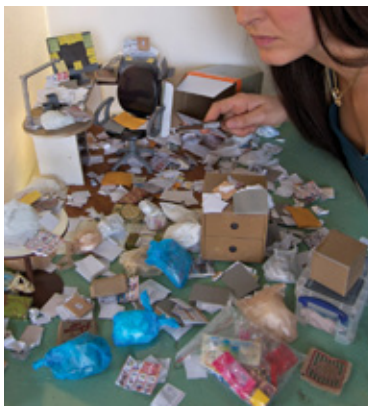
COURTESY OF THEO TVETERÅS AND LARS MARCUS VEDELER

BARBIE TRASHES HER DREAMHOUSE

At first sight, they look like real-life scenes from the television show *Hoarders,* precleanup. In reality, they are photographs of 1:6 scale dioramas by St. Louis–born artist Carrie M. Becker. She makes the cardboard boxes, garbage bags and other trash herself. The furniture and tiny objects are from Barbie's dream house and a Japanese miniatures company called Re-Ment. Becker filths up the rooms with actual dirt collected from the filter of a Dust-Buster, using the occasional Re-Ment meatball to simulate dog poop on the floor. When she photographs the scenes without an external reference, our brain relies on our everyday experience and assumes that the minuscule objects are life size. Only in proximity to an extraneous, actual-size object does the illusion fail.

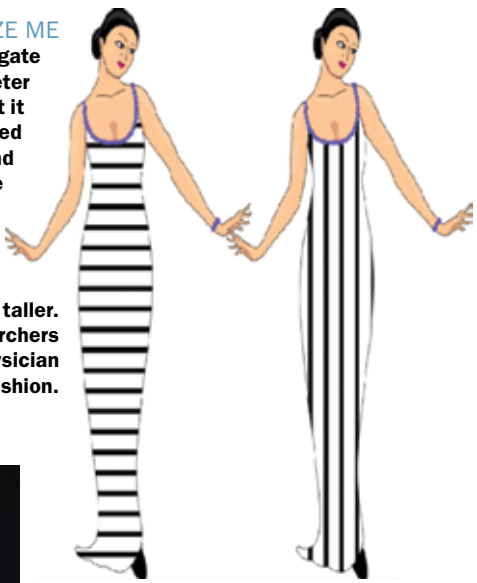






SUPERSIZE ME

You can look 10 pounds thinner with a well-known slimming trick: vertical lines elongate your shape and give you a more svelte appearance, right? Wrong! Vision scientists Peter Thompson and Kyriaki Mikellidou of the University of York in England say instead that it is time to ditch your vertical-striped wardrobe and invest in some horizontal-striped outfits. They found that vertical stripes on clothing make the wearer appear fatter and shorter than horizontal stripes do. Notice that the vertical-striped lady seems to have wider hips than the horizontal-striped model in the accompanying cartoons. The phenomenon is based on the Helmholtz illusion, in which a square made up of horizontal lines appears to be taller and narrower than an identical square made of vertical lines. The original report from 1867 of this illusion contained the intriguing reflection that ladies' frocks with horizontal stripes make the figure look taller. Because the remark ran counter to contemporary popular belief, the York researchers decided to put it to the test, finding that 19th-century German physicist and physician Hermann von Helmholtz did indeed have a great eye for fashion.



FULL MOON

The full moon rising on the horizon appears to be massive. Hours later, when the moon is high overhead, it looks much smaller. Yet the disk that falls on your retina is not smaller for the overhead moon than it is for the rising moon. So why does the overhead moon seem smaller? One answer is that your brain infers the larger size of the rising moon because you see it next to trees, hills or other objects on the horizon. Your brain literally enlarges the moon to fit the context. Look for this effect the next time you see the moon in real life.

BLOWN AWAY

Objects project smaller images on our retinas as they move away from us, which can make it hard to decide if an item is truly small or just far away (as we see in this photograph). Forced perspective photography uses this ambiguity to great effect, while eliminating many of the habitual strategies that our brain uses to distinguish size from distance, such as stereopsis (our visual system can calculate the depth in a scene from the slight differences between our left and right retinal images) and motion parallax (as we move, objects closer to us move farther across our field of view than distant objects do).

TALL AND VENTI

Is your cuppa joe half empty or half full? It depends on your outlook—and on a little twist on the Jastrow illusion, named after Polish-born American psychologist Joseph Jastrow. In this classic illusion, two identical arches positioned in a certain configuration appear to have very different lengths. Magician Greg Wilson and writer and producer David Gripenwaldt realized that Starbucks coffee sleeves have the perfect shape for an impromptu demonstration of the Jastrow illusion, so now you can amaze your office mates at your next coffee break. All you need to do is align the coffee sleeves as in the accompanying photograph and—presto!—your tall cup sleeve is now venti-sized! Your brain compares the upper arch's lower right corner with the lower arch's upper right corner and concludes, incorrectly, that the upper sleeve is shorter than the lower sleeve. We would like to thank magician Victoria Skye for her demonstration of the Jastrow illusion with Starbucks coffee sleeves. M

(Further Reading)

- **Sleights of Mind: What the Neuroscience of Magic Reveals about Our Everyday Deceptions.** S. L. Macknik and S. Martinez-Conde, with S. Blakeslee. Henry Holt, 2010.
- **Applying the Helmholtz Illusion to Fashion: Horizontal Stripes Won't Make You Look Fatter.** P. Thompson and K. Mikellidou in *i-Perception,* Vol. 2, No. 1, pages 69–76; 2011.
- **It Was as Big as My Head, I Swear!: Biased Spider Size Estimation in Spider Phobia.** M. W. Vasey, M. R. Vilensky, J. H. Heath, C. N. Harbaugh, A. G. Buffington and R. H. Fazio in *Journal of Anxiety Disorders,* Vol. 26, No. 1, pages 20–24; January 2012.
- **Weapons Make the Man (Larger): Formidability Is Represented as Size and Strength in Humans.** D.M.T. Fessler, C. Holbrook and J. K. Snyder in *PLoS ONE,* Vol. 7, No. 4, Article e32751; 2012.

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The Curious Perils of Seeing the Other Side

Taking a walk in someone else's shoes can backfire—if you do it in the wrong way or at the wrong time

BY JAMIL ZAKI

IN 2007 a Palestinian youth named Tareq attended an unusual summer camp. Organized by the foundation Seeds of Peace, the camp is designed to facilitate closeness between Israeli and Palestinian teenagers, who spend a week together canoeing, hiking and—more important—discussing their experiences of the conflict in which their two nations are entrenched. Tareq's reactions were not what he expected, however. In this idyllic setting, hearing his Israeli counterparts bare their thoughts and feelings, he knew he should come to see them as people just like himself. Instead the more he thought of the Israeli teens' point of view, the *less* he sympathized with them.

Our intuitions—and a great deal of psychological theory—suggest that "perspective taking," the proverbial walk in someone else's shoes, can cure many of our interpersonal ills. Thinking deeply about another person's experience should reduce prejudice, shrink the aisle separating political factions and even bring an end to violent conflict. The logic is that problems between groups often amount to a misunderstanding. As such, time spent together—a cup of coffee here, a beer summit there—will lead individuals on either side to understand that they are more similar than they imagined, dissolve their misconceptions and begin to erase their divisions.

This logic is usually valid. Decades of research demonstrate that perspective taking often increases people's sense of camaraderie and similarity to others, while fostering prosocial behaviors such as helping and cooperation. It can also encourage generosity, even toward members of groups such as opposing political parties that a person initially disdained. Yet this approach sometimes fails. In fact, a growing number of studies emphasize the ironic, harmful effects that perspective taking can have.

Group Conflicts

Organizations devoted to resolving conflicts often use perspective taking as an antidote to long-standing animosity between ethnic and political groups. Yet Tareq's experience suggests this strategy may be misguided. Two years after his Seeds of Peace summer Tareq sought out—and eventually worked with—neuroscientist Emile Bruneau of the Massachusetts Institute of Technology, who studies the psychology of intergroup conflicts. According to Bruneau, numerous studies have shown that perspective taking works to improve the attitudes of dominant groups toward stigmatized ones—for example, that thinking about the mind of a homeless person makes us more amenable to helping him—but this method by no means has to translate to groups locking horns with one another.

In fact, Bruneau recently demonstrated that during a conflict, the effects of perspective taking might differ dramatically depending on who is walking in whose shoes. In work carried out across two continents and described in a forthcoming paper, Bruneau found that relatively dominant conflict groups (in his studies, Israelis and white Americans) feel more positively about their nondominant counterparts (Palestinians and Mexican immigrants, respectively) after taking their perspective but that swapping places mentally has no such beneficial effect for lower-status groups. In fact, listening to the point of view of white Americans actually wors-

SÉBASTIEN THIBAULT

ened the attitudes of Mexican immigrants toward this group.

One possible reason for this failure is that less powerful individuals already engage in frequent perspective taking, so more of the same will not budge their attitudes. In a study published in 2011 psychologist Michael Kraus, now at the University of Illinois, and his colleagues found that because the well-being of individuals with lower social status is often subject to the changing whims of others, they tend to pay closer attention to others' minds than do more powerful individuals. Another possibility is that nondominant groups or individuals—students, say, or low-ranking employees—may feel as though their own perspective is too often ignored, making it difficult for them to listen to the dominant side's point of view. Indeed, Bruneau found that nondominant people's attitudes about disputes improved not after perspective taking but after "perspective giving"—that is, describing their own experiences to attentive members of higher-ranking groups. As Bruneau describes it, "nondominant groups express a strong desire to be heard or, in their words, to 'speak truth to power.'"

Talking Shop

Though less bloody than intergroup strife, business negotiations can turn ugly, too, especially when one party engages in dirty tactics. In an as yet unpublished study psychologist Adam Galinsky of Northwestern University asked mock negotiators to imagine the tactics that the person on the other side of the table would be willing to use—a classic method for fostering perspective taking. What he found was startling: "When you thought about the other person, you were more likely to act unethically," Galinsky says. Considering a competitor's position even caused negotiators to act unethically toward *other* people, for example, by lying to an experimenter about how well they performed on a task that was unrelated to the negotiation.

Galinsky believes that the competitive nature of business negotiation may produce a sense of threat, causing perspective takers to disproportionately focus on a rival's nefarious plans to cheat and cajole. This emphasis on others' malicious intent could encourage both sides to employ dirty tactics, especially when they perceive a threatening tone: "When you're in a cold state, perspective taking can warm you to cooperation. But when you're in an inflamed state, thinking about the other person's mind changes perspective taking from the glue that binds us together to the gasoline that worsens the competitive fire," Galinsky says. This insight could apply to a number of situations in everyday life: circumstances in which people are upset or angry (think marital spats) might make surprisingly bad ground for perspective taking.

What he found was startling: "When you thought about the other person, you were **more likely to act unethically**."

Treading Carefully

At first blush, Bruneau's and Galinsky's findings appear bleak. Perspective taking might help friends and colleagues cooperate if they are likely to do so anyway. Just when it is most needed—combative situations in which interpersonal understanding is badly lacking—perspective taking backfires. But the news is not all bad. Bruneau's research suggests a relatively simple way to smooth encounters between warring factions: permit members of the less dominant group to engage in perspective giving first. This work implies that in more commonplace clashes such as those between a student and mentor or an employee and boss, the person in power should make a point of allowing the less dominant individual to feel that he or she is being heard.

For business negotiators, similar framing tactics might help. Negotiations are often perceived as zero-sum: gains for one side must come at a loss to the other. This perception can ramp up the "hot" affective states that render perspective taking most damaging. Negotiations can also be couched as positive-sum, however, in which both parties can potentially gain. For example, a car salesperson and a buyer might have competing goals—pushing a car's price higher or lower, respectively—but they also have the larger, mutual goal of getting a transaction to occur. Focusing on such shared, positive-sum goals might facilitate agreement.

Stepping into another person's shoes is one of the most important aptitudes of humans. It allows us to cooperate on a grand scale and often fuels our desire to guard others' well-being. Yet instead of treating this shift in point of view as a cure-all, understanding its failures can give us a window into social interactions and tell us when—and how—getting inside someone else's head can best help us get along. M

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Searching for the Memory

New research sheds light—literally—on recall mechanisms

BY CHRISTOF KOCH

The difference between false memories and true ones is the same as for jewels: it is always the false ones that look the most real, the most brilliant.

THIS QUOTE by surrealist painter Salvador Dalí comes to mind when pondering the latest wizardry coming out of two neurobiology laboratories. Before we come to that, however, let us remember that ever since Plato and Aristotle first likened memories to impressions made onto wax tablets, philosophers and natural scientists have searched for the physical substrate of memories. In the first half of the 20th century, psychologists carried out carefully controlled experiments to look for the so-called memory engram in the brain.

One of the most influential was Karl Lashley of Harvard University. He trained rats to run through mazes, turning left here and right over there, to find bits of food. Lashley would then make lesions in various parts of their cerebral cortex, the highly convolved sheet of neurons crowning the brain and situated just underneath the skull. He crystallized the insights he obtained in his lifelong efforts in two maxims. His principle of mass action stipulated that the cerebral cortex is holistically involved in memory storage. That is, the more cortex that is destroyed, the worse the memory of the animal, with no regard to what specific part of the cortex is removed. Indeed, according to Lashley's second principle, of equipotentiality, any area of cortex can substitute for any other region as far as learning is concerned.

The most singular feature of science that distinguishes it from other human activities, such as art or religion, and gives it a dynamics all its own is progress. It results from the steady and cumulative accumulation of knowledge, the emendation and cleansing of inaccuracy and inconsistency, and the understanding that comes from constantly querying nature through empirical investigation coupled with theory. In the case of the physical substrate of memories, today's neuroscience research has turned Lashley's two principles on their head. We now know that certain brain structures, such as the hippocampus, are involved in specific types of memory. Lose that region on both sides of the brain, such as the unfortunate patient HM did [see "Mind in Pictures," on page 76], and you will not be able to form new explicit memories, whereas losses of large swaths of visual cortex leave the subjects blind but without memory impairments.

Yet percepts and memories are not born of brain regions but arise within intricate networks of neurons, connected by synapses. Neurons, rather than chunks of brain, are the atoms of thoughts, consciousness and remembering.

Implanting a False Memory in Mice

If you have ever been the victim of a mugging in a desolate parking garage, you may carry that occurrence with you to the end of your days. Worse, whenever you walk into a parking structure, you become anxious, your heart rate goes up and you begin to sweat. You have been fear-conditioned by the event. Fear conditioning has proved to be a fruitful avenue into the molecular and neuronal basis of learning and remembering. Mice, the experimental animals of choice, can easily be fear-conditioned by placing them in one particular environmental context—say, a chamber with black walls, white floor, dim lighting and the smell of vinegar—and applying brief electrical shocks to the floor under their paws. If the mouse is returned to this cage the next day, it "freezes" in place, becoming totally immobile for a fraction of a minute or longer, in anticipation of another shock. Freezing is an instinctual reaction to threats, as most predators are wired to look for movements to pinpoint their next meal. Put

CHRISTOF KOCH (*Koch*); RALF HIEMISCH *Getty Images (man with maze)*

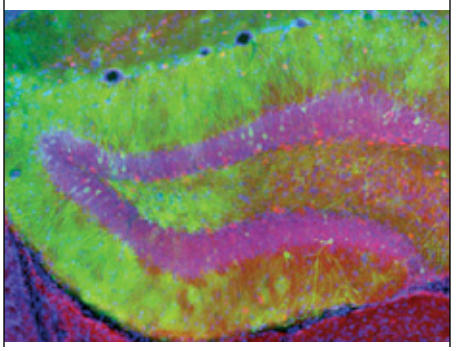
Neurons, rather than chunks of brain, are the **atoms of thoughts,** consciousness and remembering.

the mouse into an environment that looks and smells different from the one it was conditioned in, and much less freezing occurs.

Two American teams of researchers, one at the Massachusetts Institute of Technology led by Susumu Tonegawa and a second one under Mark Mayford of the Scripps Research Institute in La Jolla, Calif., exploited this standard test to manipulate the engram for this scary event. Part of the engram is found in the dentate gyrus (DG), a substructure of the hippocampus, in the M.I.T. study, whereas the Scripps study did not specify the location of the engram. Shocking an animal in one context will activate a small subset of DG neurons, around 2 to 4 percent. A different context will be encoded by a separate sparse group of DG cells. The electrical activity in these cells triggers the expression of a small number of so-called immediate early genes.

Both groups used mice that were genetically manipulated so that the increased production of one of these genes within a particular time window triggers a cascade of cellular events that ultimately leaves a permanent molecular tag on the cell that can be made to glow. This labeling allowed the experimentalists to later identify and reactivate the same set of previously firing neurons using either beams of blue light introduced via fiber-optic cable (the M.I.T. group) or delivery of a drug not naturally present in the animal (the Scripps group). These manipulations—deep-brain stimulation on steroids—are made possible by the fantastic marriage of three technologies: pharmacology, optical stimulation and molecular biology [see "Playing the Body Electric," by Christof Koch; Scientific American Mind, March/April 2010].

Now I will concentrate on the findings from M.I.T. They had a group of mice explore one particular environment (let's call it A). Later on, bombarding the DG with blue light triggered the



Neurons tagged with specific proteins (*green*) allow the astute experimentalist to track down and manipulate memories. Perhaps one day these technologies can be adopted to delete old memories and implant new ones at will?

minority of neurons that had been active while the rodents were getting used to this context. A few days later the same animals were placed into a new context—cages that looked and smelled different (environment B)—while they were electrically shocked. This robustly activated DG neurons that were furiously encoding anything and everything about this obviously dangerous place so that the mice could avoid it in future. As in all these transgenic mice, the activity molecularly labels these cells for subsequent reactivation.

In the crux of the experiment, the rodents were dropped into the neutral environment A that they had no cause to fear. Indeed, without blue light these animals did not show any freezing. Yet in a beautiful confirmation of the power of optogenetics, when the blue light was turned on, the mice froze! Triggering the neurons that encoded environment B, including its association with the painful shock, induced the memory and made the mice cower in expectation of something bad about to happen. That is, neural circuits in the dentate gyrus of the hippocampus wired up to express an aversive event that happened at B are sufficient to evoke the associated aversive memory, even though the subjects never had experienced anything bad in A. It is an artificial memory—think *Total Recall*—but to the mice it appeared real enough that they went into their defensive crouch.

This experiment proves that activating on the order of 10,000 interlaced neurons in one very specific region of the brain is *sufficient* for a specific memory, its engram. Whether these circuits are also *necessary* for this memory, that is, whether deleting these neurons will remove the memory—shades of *Eternal Sunshine of the Spotless Mind*—remains to be determined (soon).

Let me end with another evocative quote from a film that routinely tops the list of the best science-fiction movies ever. I leave it to you, esteemed reader, to discover its source. It is a death soliloquy that speaks to the clarity and lucidity of memories, real or false ones:

> *I've seen things you people wouldn't believe. Attack ships on fire off the shoulder of Orion. I've watched c-beams glitter in the dark near the Tannhäuser Gate. All those moments will be lost in time, like tears in rain. Time to die.* M

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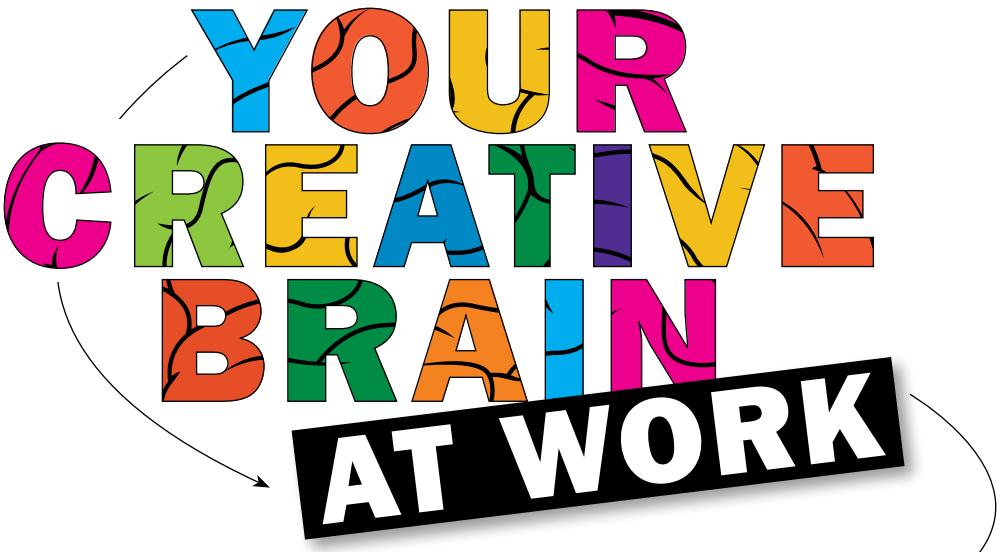


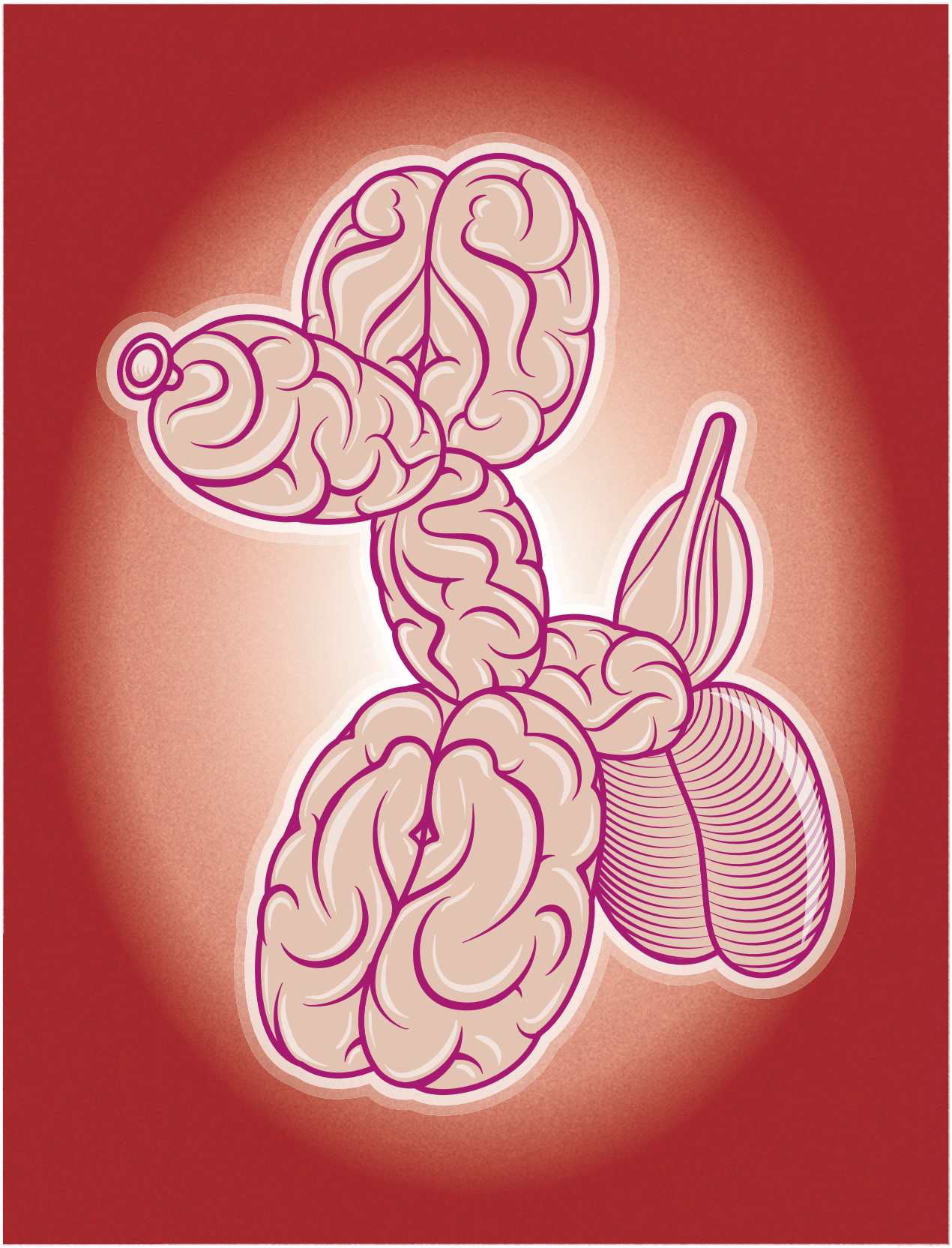
Scientists have mapped the innovative mind so that we can remake our own in its image

By Evangelia G. Chrysikou

Illustration by MCKIBILLO

During the July 4th weekend of 1994, while riding in a 1988 Chevy Blazer with his wife at the wheel, a computer engineer named Jeff Bezos laid the groundwork for a retail revolution. Back then, the Internet was an insider's tool, largely limited to government and academic circles. But after months of careful observation of its usage, Bezos envisioned a dramatic expansion of this network, one that would bring it into the daily lives of ordinary people. In the car, he sketched out a business plan for a project that would realize his vision: the Internet, he understood, could boost the efficiency of mail-order businesses, starting with books.

In a risky move, Bezos and his wife, Mackenzie, left lucrative jobs in New York's financial sector to build an Internet-based bookseller based in Seattle. They called it "Amazon," after the interminable South American river and its many branches. After a few months of testing and without any advertising, the company started racking up



Innovative ideas can arise from paying attention to the visual properties of things, such as their shape and size.

$20,000 weekly in sales. In just a few years Amazon was worth billions. Bezos forever changed how people purchase goods and made a lasting impact on the business world.

For entrepreneurs worldwide, Amazon.com is a model of innovation. Yet creativity can come in many forms. Consider Procter & Gamble's line of Swiffer products: a reconceptualization of mops, sweepers and dusters based on the simple insight that cleaning with disposable parts makes the job easier and more fun. Designer Gianfranco Zaccai of Herman Miller and his team are credited with inventing Swiffer, which reaps more than $500 million in annual sales.

Innovation matters in an enormous variety of professions. It elevates the careers of chefs, university presidents, psychotherapists, police detectives, journalists, teachers, engineers, architects, attorneys and surgeons, among other professionals. The contributions of creative thought can directly translate into career advancement as well as financial rewards. In an unfavorable economic climate, raising your creative game may even mark the difference between survival and failure.

FAST FACTS

Breaking the Rules

1» **Innovation matters in an enormous variety of professions. It elevates the careers of chefs, university presidents, psychotherapists, police detectives, journalists, teachers, engineers, architects, attorneys and surgeons, among other professionals.**

2» **Although creativity was long considered a gift of a select minority, psychologists have now revealed its seeds in mental processes, such as decision making, language and memory, that all of us possess.**

3» **Techniques for boosting creative potential may involve breaking down established ways of viewing the world or invoking unconscious thought processes.**

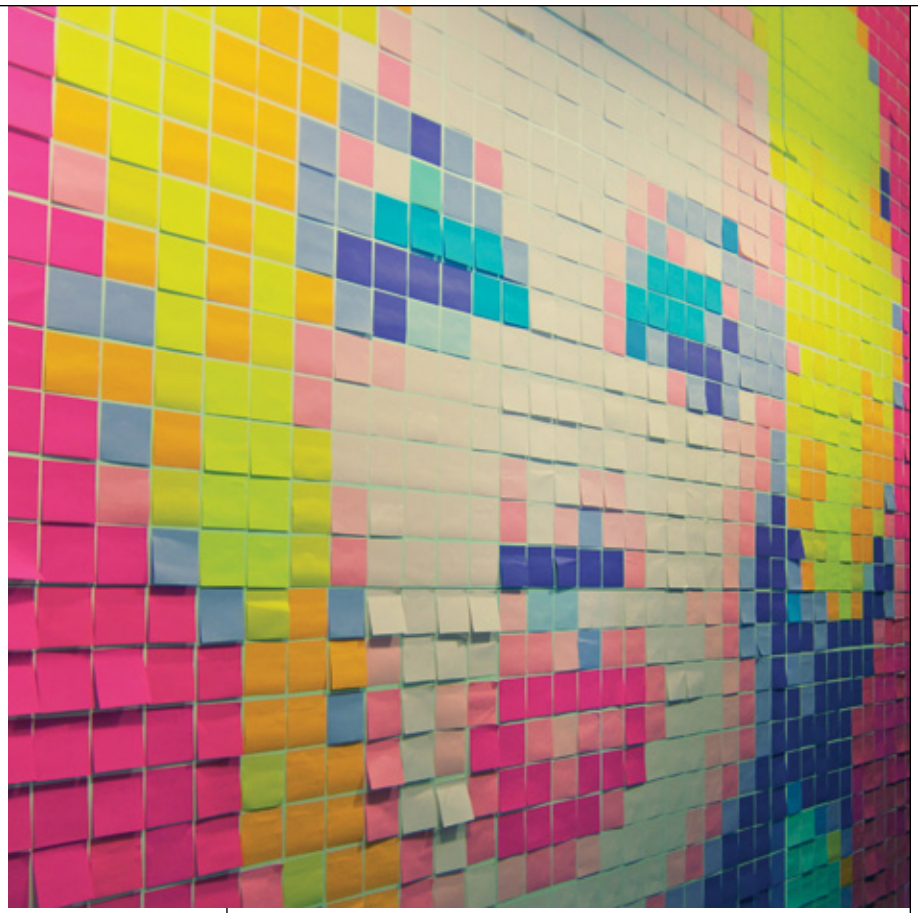
Psychologists broadly define creativity as the purposeful generation and implementation of a novel idea. In the workplace, it may be more aptly characterized as the effortful pursuit and implementation of novelty that results in *measurably useful* outcomes. In numerous studies over the past few decades psychologists have tried to unravel the mysteries of exceptional creativity in the arts or sciences, considering the likes of Pablo Picasso, Mozart, Virginia Woolf, the Wright brothers and Albert Einstein. These investigations, along with others into the origins of everyday problem solving, have uncovered genetic, social and economic factors (as well as lucky circumstances) that contribute to creative thought.

Although creativity has long been considered a gift of a select minority, psychologists are now revealing its seeds in mental processes, such as decision making, language and memory, that all of us possess. Thus, we can all boost our creative potential. Recent studies show promise for techniques that break down people's established ways of viewing the world as well as strategies that encourage unconscious thought processes. Read on to try these at home—or at work.

An Open Mind

Iconic individuals such as Bezos, the late Steve Jobs, Martha Stewart, Steve Ells (founder of the successful Chipotle Mexican Grill restaurants) and many others have inspired entrepreneurs and professionals to hone their creative skills. Individuals and companies have typically used creativity workshops, brainstorming sessions, self-help books, training videos and even hypnosis as vehicles for such improvement. Whether such practices influence the likelihood of creative leaps is unknown. Yet psychologists and neuroscientists have made some important discoveries that can help us understand the states of mind that benefit creative thought.

When people consider creativity, they generally think of the birth of novel ideas. Idea generation is indeed the first important stage of the creative process. To come up with new ideas for achieving a goal, you need, roughly speaking, an open mind—that is, one guided by minimal rules and constraints. In 2009 neuroscientist Sharon Thompson-Schill of the University



Generating novel applications for objects—such as this use of sticky notes in a mural—seems to benefit from less filtering of knowledge and experiences. A more porous mental filter enables us to consider a greater variety of possible solutions.

COURTESY OF PETER HELLBERG

of Pennsylvania and her colleagues proposed that creative inspiration might benefit from a state of lower cognitive control—that is, fewer restrictions on your thoughts and behavior.

Your more prosaic, rule-guided thought is associated with a burst of activity in your prefrontal cortex, a region on the surface of the brain behind your forehead that regulates your decisions, thoughts and actions. When you abandon rules or blur your attentional focus, this region quiets down. Thompson-Schill's team called this resulting state hypofrontality and hypothesized that it holds various benefits for language learning and creative thought, among other aspects of cognition.

Researchers found early hints of hypofrontality in the mid-1990s, when they measured the electrical activity in the brains of people who were generating new ideas. By picking up electrical waves on the scalp, scientists can get a sense of a person's "brain state," say, awake or asleep, focused or relaxed. When someone is engaged in a task that requires cognitive control and focused attention—for instance, solving a math problem or deciding what to pack for a camping trip—so-called beta waves, which oscillate at a frequency of 15 to 20 hertz, usually dominate. When people came up with new ideas, however, researchers recorded alpha waves over the prefrontal cortex. These eight- to 12-hertz waves are typically a sign of relaxed wakefulness and diffuse attention. Their presence thus bolstered the notion that idea generation is associated with a state of lower cognitive control.

The behavior of patients whose frontal lobes have partially degenerated as a result of frontotemporal dementia or similar disorders is consistent with this view. These individuals show severe impairments in regulating their thoughts and actions but may experience spontaneous musical or artistic creativity they lacked before they got sick. [For more on the link between creative thinking and unconventional behavior, see "The Unleashed Mind," by Shelley Carson; Scientific American Mind, May/June 2011.]

More recent data strengthen the case for the importance of hypofrontality in everyday creativity. In a study published in 2011 Thompson-Schill and I showed participants pictures of ordinary objects (tissues, for example) and asked them to tell us either a common use (wiping your nose) or an uncommon application (protective stuffing for a package) for each one. Participants who came up with unusual uses for the items showed minimal activity in prefrontal brain regions and heightened activity in posterior brain regions that are typically in charge of visuospatial skills. In contrast, those who thought of typical uses showed the reverse pattern. Thus, generating novel applications for objects also seems to benefit from less filtering of knowledge and experiences, which enables people to consider a greater variety of possible answers.

What is more, innovative ideas can arise from paying attention to the visual properties of things, such as their shape, size and material makeup. Instead of highlighting previous knowledge, the brain enters a state that emphasizes often overlooked perceptual elements.

Scientists have been able to mimic this brain state by applying electrical stimulation to the scalp and thereby improving problem-solving ability. These data lend considerable credence to the idea that diminished activity in the prefrontal cortex, particularly on the left side of the brain, underlies an important part of the creative process [see "Tickling the Brain," on page 29].

If you are struggling with a difficult project at work, take a break. The recess may shake loose some creative thoughts, especially if you choose to do something dramatically different from what your job entails.

HANS NELEMAN *Corbis*

Thought Control

In addition to idea generation, true creativity involves evaluating your options, picking the best one and implementing a plan for realizing your vision. This evaluation process, the second critical stage of creative thought, involves a mental state in which the cognitive filter in the prefrontal cortex is on instead of off. In a study published in 2011 psychologist Kalina Christoff of the University of British Columbia and her colleagues asked college students from the Emily Carr University of Art + Design in Vancouver to generate illustrations for book covers on a special drawing tablet while inside a brain scanner. The students were asked to come up with ideas for their sketches for 30 seconds and then spend 20 seconds evaluating what they had sketched. The researchers found that the prefrontal cortex among other regions were *more* active during the evaluation stage, suggesting that the executive-control network that filters data and exerts brakes on behavior is *more* engaged during the evaluative phase of the creative process.

Creative individuals may thus be those who are better able to upregulate or downregulate their cognitive-control system depending on the demands of the situation—a skill known as cognitive flexibility. In a 2010 study Darya Zabelina and Michael Robinson, both then at North Dakota State University, first assessed the creativity of 50 undergraduate students using standard paper-and-pencil tests and then measured their capacity for cognitive control with the Stroop task. In this task, people are given a list of color words ("yellow," "blue," "red," and so on) that are typed in a color that often does not match the word. The goal is to state the color of the word regardless of what the word says. This task measures how well a person can filter out irrelevant information to focus on what is important, a major feature of cognitive control. Although creative and noncreative subjects performed equally well on this task overall, creative subjects did better every time they had to switch from a matching combination (for instance, the word "red" appearing in red type) to a clashing one ("red" showing up in blue letters). These results indicate that creative people show greater cognitive flexibility, which can support the ability to both generate novel ideas and put these ideas into action.

Psychologists have been exploring ways to expand our creativity, enhancing the arsenal of techniques that promote idea generation and implementation. Some of these methods appear in the sections that follow.

Mental Push-ups

Exercises that shake up people's typical ways of thinking can help put them in a creative mind-set. A version of the alternative-uses task described earlier, for example, can get people to rethink the way they categorize objects. In a study published in 2006 my colleagues and I asked college students to devise up to six alternative uses for 12 common objects in 15 minutes. Then we asked them to solve practical problems, such as affixing a candle upright on a wall using a book of matches and a box of tacks. (Hint: think of the box as a platform.) For some of the students, the objects in the first task were related to the practical problems; for others, they were not. These two groups did equally well on the practical problems, however, and both solved significantly more of them than did students who had not completed the alternative-uses task. Thus, the training task seemed to benefit our subjects more generally, putting them in the right state of mind for creative problem solving.

Another method for boosting creativity might be to describe objects in unusual ways—for example, in terms of their

Tickling the Brain

Neuroscientists have been able to tweak the creative process by enhancing or suppressing activity in frontal brain regions. In a technique called transcranial direct-current stimulation, minute amounts of electric current flow through a pair of electrodes affixed to the scalp and thereby either raise or lower activity in the underlying brain regions.

In a study published in 2011 neuroscientist Allan Snyder of the Center for the Mind in Sydney and his colleagues used this method to affect the ability of individuals to solve arithmetic puzzles involving matchsticks (*right*). The initial problems could all be solved using a similar strategy, but the last two required abandoning what had worked before and developing a novel approach. Snyder's team hypothesized that the right hemisphere enhances creativity, whereas the left hemisphere impedes it. Indeed, when the researchers depressed activity in the left frontal cortex while exciting the right frontal cortex in some of their subjects, these individuals solved the last two problems at higher rates than those who received the opposite pattern of stimulation (left excitation, right inhibition) or sham stimulation.

Beyond fostering alternative problem-solving strategies, this neurostimulation technique can also support the generation of novel ideas, such as finding new uses for objects. In a study earlier this year my colleagues and I inhibited neural activity in the left prefrontal cortex of participants while they came up with a common or an uncommon use for objects presented to them in pictures. These individuals thought of significantly *more* uncommon uses—and did so about a second faster—than did people who received inhibitory current over their right prefrontal cortex or those who were given sham stimulation. These results strongly support the hypothesis that blocking cognitive filtering by inhibiting the left prefrontal cortex during idea generation can promote creative thought.

—E.G.C.

TYPE	FALSE STATEMENT	SOLUTION
1	III=IX−I	III=IV−I
2	VI=VI+VI	VI=VI=VI
3	IX=VI−III	IX−VI=III

People who made a sandwich in an unconventional way came up with more varied answers to open-ended questions.

features rather than their function. In a 2012 study psychologist Tony McCaffrey of the University of Massachusetts Amherst trained students to define objects generically by their shape, size and materials. A candle might be described as wax and wick or, even more obscurely, as string and cylindrically shaped lipids. McCaffrey encouraged the students to ask themselves, "Can I break the description down any further?" and "Does my description imply a particular use?" Participants who received this training showed a 67 percent boost in problem-solving performance relative to those who did not. One reason for their advantage: they were more likely to notice obscure features of the problems that were necessary for their solution.

Performing common tasks in an unconventional order can also upset your ordinary thought processes and thereby raise your creative prospects. In a 2012 study psychologist Simone Ritter of Radboud University Nijmegen and her colleagues asked a group of students to prepare a breakfast sandwich with butter and chocolate (a popular combination in the Netherlands). Half of them made the sandwich the regular way, and the rest were prompted to do so following an unusual sequence of steps. All the students were then given two minutes to generate uses for a brick and another two minutes to come up with as many answers as they could to the question "What makes sound?" Those who made the sandwich in an unconventional way—an activity that violated their expectations, the researchers theorized—came up with more different types of answers and thus scored higher on cognitive flexibility.

If mental exercises are not giving you enough good ideas, try enlisting your unconscious. One trick for achieving this mental power shift is to sleep on the problem. In particular, the stage of sleep known as rapid eye movement or dream sleep can help establish associations between remote ideas. These links may bring out solutions to conundrums that stumped you just before dozing off [see "Answers in Your Dreams," by

(The Author)

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ANNE-LOUISE QUARFOTH *iStockphoto*

Those who saw themselves in the distant future solved more problems than those who simply imagined the following day.

Aim to Innovate

Try these tips to maximize your creativity at work.

Become an expert. A solid knowledge base will allow you to connect remote ideas and see their relevance to a problem.

Observe. When trying to come up with a new product or service, carefully study how people use what is currently available and what problems they face.

Know your audience. Walk in the shoes of the intended consumer. How would a child use a remote control? How would an elderly person access a voting booth? How can I make this dessert for a vegan?

Step out of your comfort zone. Seek activities outside your field of expertise. Take a class; read a book; travel to a foreign country. New experiences often bring forth novel thoughts.

Be willing to work alone. Group brainstorming can help you synthesize your ideas, but it is far more effective if you have started the creative process on your own.

Talk to outsiders about your work. A novel perspective can help you see alternative solutions or possible faults with your original idea.

Have fun. A good mood can forge remote associations. Upbeat music may help but also makes tasks that demand focus more difficult. If you need to concentrate, dampen your demeanor with sad songs.

Take a nap or let your mind wander. Sleep and daydreaming can enlist your unconscious mind to work on a problem that is stumping you.

Take a break. Occupying your mind with a different task can unleash novel solutions.

Challenge yourself. Disrupt your daily routine. Abandon your initial idea (even if it works) and look for a new one. Borrow from other people's answers and try to improve on them.

Dierdre Barrett; Scientific American Mind, November/December 2011].

Similar benefits can come from letting your mind wander or deliberately distracting yourself. In a 2006 study psychologist Ap Dijksterhuis, also at Radboud University, and his colleagues asked people to generate novel names for products. Those who were sidetracked by a different task thought of more original names than those who worked on the problem continuously. In later studies, Dijksterhuis's team demonstrated that unconscious processing could yield answers to very difficult problems that require an extensive search of stored knowledge. These results suggest that if you are stuck on a difficult problem, it pays to take a break and do something else. [For more on the benefits of daydreaming, see "Living in a Dream World," by Josie Glausiusz, Scientific American Mind, March/April 2011.]

What you do during your break turns out to be important, too. In a 2009 study psychologist Sophie Ellwood of the Center for the Mind in Sydney and her colleagues asked participants to think of as many uses as they could for a piece of paper. Some performed the task continuously for four minutes; others paused after two minutes and did a similar exercise (thinking of synonyms for words) for five minutes before getting back to the paper task. A third group used the break to complete a personality questionnaire. The people who took a break generated more uses for the paper than those who were not interrupted, but those who did the unrelated activity performed the best on this creative task.

Keeping Your Distance

Many other social and emotional factors can spur creative thought. One of them is thinking of a problem as physically far away. Psychologist Lile Jia of Indiana University Bloomington and his colleagues gave students practical problems similar to the one involving a candle discussed earlier. They told some participants that their responses would be collected for scientists at a university a few thousand miles away and others that a research team at their own university would get the results. A third group of students received no information about the study's whereabouts. Remarkably, the students who thought they were solving the problems for the faraway inves-

MATT HENRY GUNTHER *Getty Images*

Working alone is usually the best way to come up with creative solutions. Once you have some ideas, casual interactions with others can help you develop them.

tigation solved twice as many problems as the other students. The researchers hypothesized that the psychological distance caused the students to approach the problems in more abstract terms, thereby facilitating their solution.

Distancing yourself in time can also promote innovation. Psychologist Nira Liberman of Tel Aviv University and her colleagues asked participants to imagine themselves either one day or one year in the future. Then the researchers gave their subjects a series of problems to solve and asked them to imagine themselves working on them on that future day. Those who pictured themselves in the distant future solved significantly more problems than those who simply imagined the following day.

Beyond psychological distance, physical distance from others can also increase creative output. Despite its presumed benefits, group brainstorming is beneficial only after you have come up with a few solutions for a complex problem on your own, recent research suggests. In addition, brainstorming works better in the context of casual, brief semistructured social interactions such as a lunch or social gathering than in long, organized meetings. Interactions among people with varied backgrounds—say, those who have different but related fields or those who work at other places—are especially good at promoting the synthesis and development of new ideas.

But no matter how imaginative our thoughts, we still must cross one major hurdle: our fear of risk. People tend toward safe routes, yet safety is not conducive to radical new solutions. Bezos and his wife not only had to come up with the notion of Amazon. They also had to be willing to cast off their current careers to pursue an uncertain future. Amid the financial and other practical and professional constraints of most workplaces, not to speak of other life concerns, abandoning a satisfactory but safe solution to pursue a new concept may be the biggest challenge to capitalizing on creative potential. As Bezos once said, "Innovation is disruption." M

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Microbes on Your Mind

Bacteria in your gut may be influencing your thoughts and moods

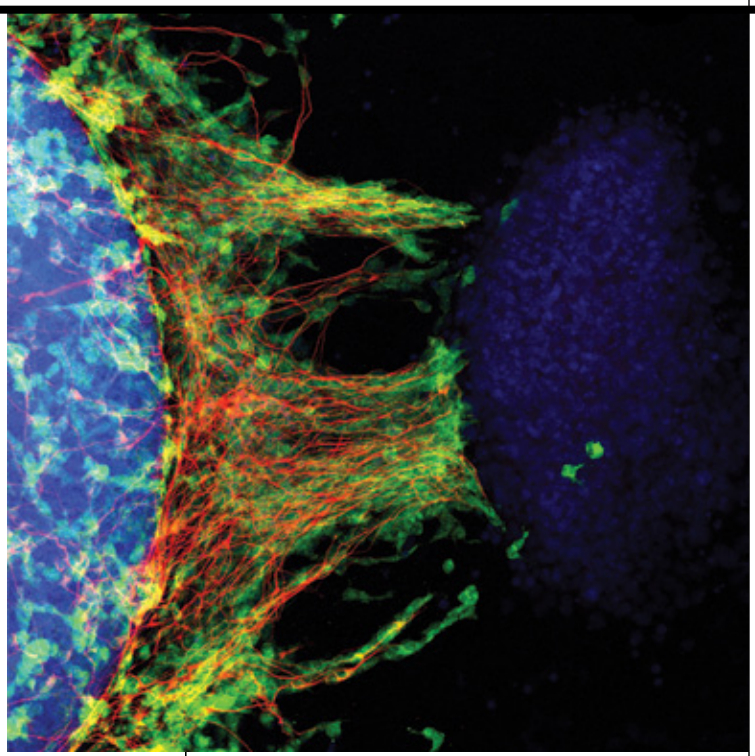
By Moheb Costandi

The thought of parasites preying on your body or brain very likely sends shivers down your spine. Perhaps you imagine insectoid creatures bursting from stomachs or a malevolent force controlling your actions. These visions are not just the night terrors of science-fiction writers—the natural world is replete with such examples.

Take *Toxoplasma gondii*, the single-celled parasite. When mice are infected by it, they suffer the grave misfortune of becoming attracted to cats. Once a cat inevitably consumes the doomed creature, the parasite can complete its life cycle inside its new host. Or consider *Cordyceps*, the parasitic fungus that can grow into the brain of an insect. The fungus can force an ant to climb a plant before consuming its brain entirely. After the insect dies, a mushroom sprouts from its head, allowing the fungus to disperse its spores as widely as possible.

Microbes that manipulate the behavior of their host are not limited to nature's dark corners, although those examples are vivid. Our body hosts vast numbers of foreign microorganisms, some of which wield unseen powers over us. These

Illustration by Brian Stauffer



The green cells shown above are in the process of developing into enteric neurons (*red*), which control gut function independently of the brain.

COURTESY OF VALENTINA SASSELLI *National Institute for Medical Research*

microbes are not parasites—they live on and in our body, mostly in our gut, and often strike up a symbiotic relationship with us.

Composed mostly of bacteria but also viruses and fungi, this so-called gut microbiota churns out a complex cocktail of biologically active compounds. Some of these products closely resemble human hormones and neurotransmitters, the chemicals that neurons use to communicate with one another. Microbes in the gut (the small and large intestines and the stomach) have long been known to play a role in human health. Irritable bowel syndrome and stomach ulcers, for example, are linked to an imbalanced microbial population.

In the past few years scientists have been discovering that these microscopic inhabitants of our body may be subtly altering our moods, emotions and perhaps even our personalities. Gut microbiota appear to alter gene activity in the brain and the development of key regions involved in memory and learning. These denizens of our intestines could help explain why psychiatric symptoms vary among individuals, as well as their responses to medications. Gut microbes could also account for some of the differences in mood, personality and thought processes that occur within and among individuals.

Early clinical trials are even suggesting that probiotic supplements could treat mood disorders. Eventually we may learn that our bacterial soup contains markers for diseases, which could be detected cheaply and quickly. "Research into the gut microbiome has the potential to change many aspects of health and biotechnology," says molecular biophysicist Rob Knight of the University of Colorado at Boulder.

Your Microbial Self

From the minute you are born, microbes begin to colonize every exposed surface and organ of your body. By age three the gut contains a full complement of approximately 100 trillion microbes. According to most estimates, about 500 different bacterial species call your intestines home, with 30 to 40 species making up the bulk of the population. Family members' microbial compositions are more similar to one another than to unrelated people, and identical twins are most alike of all, suggesting that genetics helps to determine the intestinal inhabitants we acquire.

The variety among people can be glimpsed with something as simple as a swab of your computer keyboard. In 2010 Knight and his colleagues showed that the bacteria on a computer keyboard resembled the bacterial community on that computer user's fingers more closely than the populations dwelling on a different keyboard or another person's hand. The genomes of these microorganisms harbor approximately 100 times more genes than our own DNA. "Ninety percent of the cells in what we like to think of as 'our' bodies actually contain microbial genomes rather than human ones," he says.

The study of the gut's ecosystem is in its infancy, but interest in this area has been growing rapidly. Drastic reductions in the cost of DNA sequencing allow researchers to analyze large numbers of microbes simultaneously rather than having to grow them one at a time in the laboratory. Scientists can now quickly take a census of the gut and hunt for associations between microbiota and disease.

FAST FACTS

Moody Microorganisms

1» **Bacteria and viruses dwelling in our gut produce compounds that can interact with our nervous system in ways that appear to affect our anxiety and stress responses.**

2» **Early clinical trials suggest that bacterial remedies, such as probiotic supplements, may be useful in treating several types of psychological distress.**

3» **Eventually individual assessments of gut microbial communities could allow physicians and researchers to tailor treatments for mental disorders.**

In 2007 the National Institutes of Health launched the Human Microbiome Project, a five-year, $115-million initiative to sequence the DNA of as many gut microbes as possible. The following year two more groups were created: the International Human Microbiome Consortium, which seeks to build a comprehensive database, and MetaHIT, an alliance of 13 partners drawn from eight European countries in academia and industry, with $43 million in funding. These projects all seek to understand how the species populating our gut relate to our health.

Our bacterial soup may contain markers for diseases, which could one day be detected cheaply and quickly.

The composition of these communities is highly dynamic throughout life. Changes in diet, drugs and other environmental factors can unleash earthquakes on our internal ecosystem. But freeloaders they are not. Bacteria help us digest food by fermenting dietary proteins and polysaccharides. They synthesize amino acids and minerals that the body needs but does not produce itself, and they protect us from pathogens by interacting with the immune system. Microbiome diversity appears to be a good indicator of general health—it decreases with age, and people with reduced diversity not only put on weight more easily than others but also struggle more to lose a few pounds. It should come as no surprise, then, that these microscopic creatures also meddle with the mind.

The Gut-Brain Connection

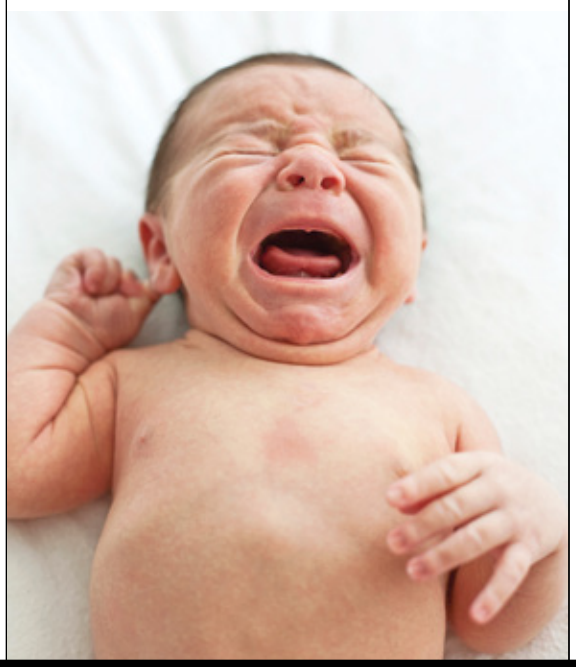
Anyone who has ever lost control of their bowels when scared is well aware of the intimate connection between the brain and the body's internal plumbing. We refer to "gut feelings" to describe an intuitive, emotional response, and we say that doing something daring "takes guts." Less obvious is that these responses are not merely emanating from a single lump of flesh, sophisticated as it may be.

Embedded in the lining of the intestines is the enteric nervous system, with hundreds of millions of neurons—one-thousandth the number in your brain. This network, colloquially termed a "second brain," controls gut function. It processes missives from the intestines and their microbes without input from brain number one. Gut neurons communicate with the brain through the vagus nerve, which extends from the base of the brain to the chest and abdomen and sends a branch of nerve fibers to the intestines.

The clearest connection between gut bacteria and the mind can be seen in how we experience anxiety and stress. In one influential study in 2004, for example, Nobuyuki Sudo of Kyushu University in Japan and his colleagues speculated that microbes might be involved in the brain's stress response. They had previously shown that gut microbes affect the development of the immune system early in life. The immune system, in turn, interacts extensively with the nervous system during this period. To investigate, they raised newborn mice in special conditions that prevented microbes from colonizing their guts. The rodents were then placed in situations designed to induce stress, in this case by restraining them.

Compared with normal mice, the germ-free mice had higher levels of stress hormones in their blood and reduced expression of the gene that codes for brain-derived neurotrophic factor (BDNF) in the hippocampus, a region important for memory formation and learning. When the brain generates new neurons, those young cells grow axons and dendrites that seek out networks of existing neurons to join. Those that encounter a burst of the protein BDNF during this process are more likely to survive and link up with other neurons; those that do not will wither away. Sudo's experiment suggested that gut microbes could influence the growth of memory and learning networks, which affected the rodents' ability to handle stress.

To strengthen the argument that microbes might be responsible for the changes, the researchers then



SIRI STAFFORD Getty Images

The gut may have a sensitive period early in life, when the colonization by gut microbes has a strong effect on behavior, whether for good or ill.

Some beneficial microbes, such as *Lactobacillus,* shown below, are often added to yogurts. In addition to aiding digestion, they may also alter moods.

colonized the germ-free mice with *Bifidobacterium infantis,* one of the most prevalent species in the microbiota and one of the first bacterial strains to settle into the gut of newborns, both human and rodent. The newly infected rodents' stress response quieted down to match that of the normal mice.

John Bienenstock and Jane Foster of the Brain-Body Institute at McMaster University in Ontario recently revisited this idea in a series of studies published in 2011. In one experiment they infected mice with a parasite that is known to induce those same effects—heightened anxiety and reduced activity of the BDNF gene in the brain. When they then introduced *Bifidobacterium longum*—another early colonizer of the gut after birth—into the mice, the parasite's effects disappeared. Somehow gut microbes seemed to be helping out the rodents' brain.

Gut bacteria are notoriously difficult to study, however. Not only are researchers mostly dependent on animal models, even creating the conditions needed to test those animals can be extremely tricky. Raising rodents free of microbes requires special facilities and equipment. In addition, labs can differ in the bacteria that inhabit their normal, or control, mice. These variations in difficult-to-track microscopic conditions can lead to seemingly conflicting results. The overall message, however, is that gastrointestinal microbes can change animals' emotional responses, although whether those results are positive or negative may depend on the environment both inside and surrounding the gut.

For example, Bienenstock, Foster and their collaborators recently compared the behaviors of germ-free mice with normal mice. These germ-free mice were *less* anxious than the control rodents. They also saw brain changes to match those outcomes—namely, more expression of the gene encoding BDNF in the germ-free mice and fewer receptors for the neurotransmitters serotonin in the hippocampus and glutamate in the amygdala, a brain region that processes emotions. Serotonin is a key player in mood. Glutamate, like BDNF, is critical to learning and memory, suggesting that gut bacteria might have some effect on cognitive processes beyond mood. Yet when the researchers then tried to introduce microbes into adult germ-free mice, they observed no changes to behavior. This finding implies that the microbes exert their effects during a limited developmental time window. A second, similar study of theirs, using a different microbe, found altered expression of the genes relating to another important neurotransmitter, GABA, throughout the brain. The receptors for this chemical are a target for a class of drugs commonly used to treat anxiety, including Valium.

To get a more fine-grained view, the researchers dissected a mouse's myenteric plexus, a major component of the gut's nerve network. They inserted microelectrodes into individual neurons to record the cells' responses to various bacteria. These recordings revealed that some strains of *Bifidobacterium* and *Lactobacillus,* among the most prevalent bacterial species in the human gut, could block those neurons from producing impulses and lower the rodent's visible response to abdominal pain.

Bienenstock and his colleagues speculated that these neural changes might reach the brain by way of the vagus nerve. Indeed, severing this nerve in rodents abolished the microbes' effects. A second possible line of communication has also emerged in preliminary results presented at the Microbes for Health symposium in Paris last December: some strains of gut bacteria produce short-chain fatty acids that can increase the permeability of the blood-brain barrier. These molecules might alter which substances in the bloodstream can enter the brain.

As strong as the connection may seem in rodents,

KARI LOUNATMAA *Photo Researchers, Inc. (left);* JESSICA PETERSON *Corbis (right)*

(The Author)

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similar experiments in humans are lacking, leaving many open questions about what those intestinal interlopers might be doing in more complex organisms. "The findings are intriguing, but the details of what will generalize to humans requires detailed further study," Knight says. "We know that microbes influence gene expression in many tissues, so it would be a surprise if the brain were an exception." Emeran Mayer, a professor of neurogastroenterology at the David Geffen School of Medicine, U.C.L.A., is more hesitant. Researchers do not have the opportunity to raise babies in sterile environments, nor is our nervous system as simple as a rat's. "Given the robustness of the effects, one would expect that some of them also occur in humans, particularly in the early life periods," he says. "But there is a major difference between the rodent and human brain—they do not have our extensive prefrontal cortex."

Probiotics for Your Brain

Evidence supporting a connection between gut ecology and the human brain is now trickling in. One example comes from infants—colicky babies have less diversity in their gut microbiota than is normal at that age and seem to be predisposed to stress later on. Other data are emerging from clinical trials of probiotic supplements—the microorganism-filled tablets and cultures, such as those added to yogurt, that are believed to aid digestion.

In mice, microbes can soothe skin inflamed by stress, suggesting a link between the gut, brain and skin.

In 2011 French researchers published the results of a small clinical trial examining the antianxiety effects of probiotics. They had 66 patients take either a placebo or a probiotic formulation containing *Lactobacillus helveticus* and *B. longum,* two common inhabitants of guts, for a month. The participants were evaluated for anxiety and depression according to widely accepted checklists at the beginning and again at the end of the experiment. At the end of the month the group that took the probiotics showed the greatest decrease in signs of psychological distress as measured through the participants' self-reports.

Those findings are in line with what others have observed. In a paper currently in press, Mayer and his U.C.L.A. colleague Kirsten Tillisch worked with 45 healthy female volunteers to assess the effects of taking a probiotic formulation for a month. They divided the participants into three groups: 13 subjects were given a probiotic dairy product, another group received a milk-based, nonfermented dairy product, and the remaining women took nothing. When they scanned each woman's brain, they found that compared with the two control groups, the participants given probiotics had significantly less resting-state activity—the brain's firing patterns when thinking about nothing in particular—as well as a dampened response in their arousal networks, which includes the amygdala, in response to emotional faces. "We have several other studies either ongoing or in the planning phase all aimed at investigating if chronic probiotic intake or reduction of gut microbes by antibiotics can alter human brain structure and function," Mayer says.

Ultimately the concept of the gut-brain connection will very likely prove too simplistic. A fuller understanding of the effect of microorganisms on the psychological landscape will take into account chatter among other organs and systems in the body and their respective microbial communities.

For example, acne has long been associated with anxiety and depression, and in 1930 dermatologists John Stokes and Donald Pillsbury put forward the "gut-brain-skin axis" hypothesis to explain the link. They proposed that emotional states might alter gut microbiota, which could increase the gut's permeability and lead to skin inflammation. They also advocated a probiotic remedy—a milk preparation containing *Lactobacillus acidophilus,* the common additive in dairy products. Bienenstock's group recently found evidence for this idea, showing that *Lactobacillus* soothes skin inflamed by stress and restores normal hair growth in mice.

We may yet discover that the microbes on our skin can communicate with those in our gut to influence our behavior. "It's not unreasonable to think that microbes elsewhere are involved," Bienenstock says. "Could we have some microbial ointment that improves health and well-being? The mind boggles at the possibilities." M

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DEATH BY SLEEPWALKER

Some people commit violent acts while asleep. In seeking to understand their brain states, scientists and physicians are investigating the murky borders of consciousness

By Francesca Siclari, Giulio Tononi and Claudio Bassetti

On the morning of May 24, 1987, sometime after 1:30 A.M., a 23-year-old Canadian named Kenneth Parks drove 14 miles to his in-laws' home, strangled his father-in-law to the point of unconsciousness, and beat and stabbed his mother-in-law to death. A year later he was acquitted of both assault and murder. After a careful investigation, specialists reached the astonishing conclusion that Parks had been sleepwalking—and sleep driving and sleep attacking—during the incident.

This story inspired a 1997 made-for-television movie, *The Sleepwalker Killing*, starring Hilary Swank as Parks's wife. Although such extreme cases are rare, unintended acts of violence during sleep are quite common among those with sleep disorders. In a 1995 study of 64 sleep clinic patients suffering from sleepwalking or sleep terrors, more than half exhibited harmful behavior during sleep. An analysis at a different clinic that same year concluded that 70 percent of their 41 sleepwalking patients acted in a potentially injurious way.

Evidence from population surveys confirms that sleep violence is not a trivial threat. In a 2010 review of nearly 20,000 telephone interviews across six European countries, about 1.7 percent of the respondents reported behaving violently during sleep. Because this study is based on self-reports, it may be an overestimate. Nevertheless, the findings echoed an earlier survey, in which 2.1 percent reported acting in dangerous ways while slumbering.

Ultimately sleep violence is a symptom of an underlying condition. Scientists who study these behaviors, including the authors of this article, seek to identify its psychological and neurological determinants and to produce effective treatments. What makes these reports so alarming, however, is the total lack of self-control they imply. The ability to unwittingly carry out complex actions while asleep poses a serious challenge to our sense of being in charge. Using imaging techniques, we have learned that while certain important regions of a sleepwalker's brain behave as if the person is deeply asleep—such as the frontal lobe—others are unusually active, as if the person is wide awake. These emerging findings allow us not only to explore the subtle boundaries separating normal and pathological sleep but also to probe the mysteries of consciousness and free will.

FAST FACTS
Sinister Sleep

1» **Hitting, kicking or other aggressive acts by sleepers are symptoms of an underlying condition.**

2» **Brain-imaging studies have shown that when people with an arousal disorder sleepwalk, certain parts of the brain appear to be awake while other regions stay in sleep mode.**

3» **This so-called dissociative state of the brain allows researchers to study sleep and consciousness generally. Understanding sleep violence could have legal implications.**

SAMUEL BRADLEY *Getty Images*

The boundaries between sleep and wakefulness can be disrupted, and people can become caught between these two states.

People suffering from an arousal disorder enter a dissociative state, as if beginning to wake up but failing to do so completely.

JORDAN SIMEONOV *iStockphoto*

Neither Awake nor Asleep

For as long as we have recognized walking and talking in our sleep, we have also been aware of more extreme nighttime behaviors. Homer's epics mention a sleeper's tragic suicide. In 1313 a church-led council concluded that a sleepwalking killer was not culpable for his crimes. One of the first legal cases involving sleep violence occurred in the central European region of Silesia in 1791, in which a woodcutter killed his wife with an ax and later insisted he was asleep at the time. We have no way of knowing the truth of those matters; nonetheless, the medical literature reflects many complex actions executed during sleep, including driving, eating and sex, as well as murder, suicide and rape. In fact, much of the evidence that scientists use to study extreme cases of sleep violence comes from criminal investigations and court cases.

Sleep violence tends to emerge from three main conditions: rapid eye movement (REM) sleep behavior disorder, arousal disorders and epilepsy. We will focus primarily on arousal disorders, which occur during non-REM sleep. In arousal disorders, a sleeper enters a so-called dissociative state, as though beginning but failing to completely awaken. The first brain-imaging study to observe this dissociative state was led by one of us (Bassetti) while at the University Hospital of Bern in 2000. A 16-year-old sleepwalker was monitored for two nights with electrodes placed on his scalp to produce a polysomnogram of his brain activity. On one of those nights, when the polysomnogram showed the teenager to be in deep sleep, he rose from his bed and opened his eyes, a scared expression on his face. Half a minute after he began sleepwalking, Bassetti's team injected him with a weak radioactive tracer. Several hours later the tracer would allow the researchers to produce scans of his brain activity at the time of sleepwalking.

We then compared the boy's brain activity when sleepwalking and when in deep sleep. In the sleepwalking state, scans revealed greater activity in areas of the brain involved in motor control, including the posterior cingulate cortex and parts of the cerebellum, located in the middle and at the base of the brain, respectively. Compared with the brain activity of healthy, awake subjects, the sleepwalker showed less engagement in regions responsible for higher cognitive functions, such as attention, insight, planning and judgment.

A similar pattern was found in 2009 by sleep specialist Michele Terzaghi and her colleagues at Niguarda Hospital in Milan, Italy. The researchers implanted electrodes under the cranium of a patient who suffered from both epilepsy and sleepwalking. During the study the subject sat up and spoke briefly while asleep. As in Bassetti's study, parts of the sleepwalker's posterior cingulate cortex, tucked into the middle of the brain, appeared as active as in an awake person, whereas other regions remained in a sleeplike state.

Rude Awakening

One of the important results from these studies is that during a sleepwalking episode, the brain's frontal lobe functioned

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as if in deep sleep. Among other things, the frontal lobe enables a person to understand and evaluate an action's consequences. Dysfunction in this area, seated directly behind the forehead, has been linked to violent behavior.

Low frontal lobe activity, however, does not fully explain sleep violence. Sleepwalking without incident is common in children, and for many adults the only injury comes from bumping into furniture. Mark Pressman, a doctor of sleep medicine at Thomas Jefferson University, investigated this question by analyzing 32 cases of nocturnal violence documented in the medical and legal literature. In 2007 he reported that most aggressive behavior may be provoked by encounters with other people while the sleeper is somnambulating.

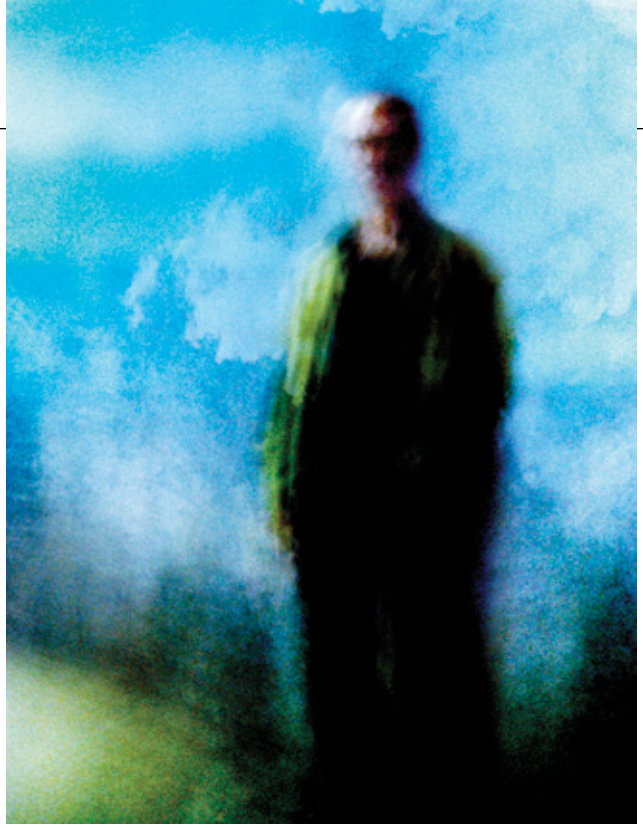
Disturbing dreams can also accompany abnormal sleep behavior. A team under medical doctor Isabelle Arnulf of Pitié-Salpêtrière Hospital in Paris interviewed 38 patients in the sleep disorder unit with questions about the content, frequency, time and activity of their sleep disorders. Sleepwalkers reported experiencing intense, nightmarish images. In the study, published in 2009, 84 percent of these images inspired fear and more than half were unhappy in content. About a quarter of individuals questioned had dreamed of being physically attacked.

Getting through the Night

Sleep is not an all-or-none phenomenon. At times, the boundaries between sleep and wakefulness are disrupted, and individuals become caught between these states. The sleepwalker who attacks a beloved family member, the narcoleptic who is conscious but suddenly rendered unable to move by a bout of laughter, and the lucid dreamer, perfectly aware of the fact that his or her experiences are not real, are all examples. Such cases of unusual sleep offer a window into consciousness. Not only does consciousness vanish when we doze off and reappear in full on waking, it can assume a variety of forms. It can range from brief images that flash by as sleep sets in to vivid hallucinatory experiences in dreams later in the night.

These observations inevitably raise difficult questions. What determines the level of consciousness during sleep and wakefulness? Which parts of the brain must be awake to carry out actions deliberately, with full knowledge of their consequences? How culpable is a person like Kenneth Parks for his behavior? Only further study of the brain and behavior, awake and asleep, will yield the answers.

So far this work underscores that sleep and wakefulness can coexist in the brain. Sleep can occupy certain populations of



DEBORAH DAVIS *Getty Images*

Consciousness assumes many forms. It can range from flashes of images as sleep sets in to vivid hallucinations in dreams later on.

brain cells but not others. This observation has consequences for a healthy person's waking life as well. Think of the last time you had a poor night's sleep. There is a good chance that the next day, parts of your brain were off-line while the rest was humming along in a normal waking state. This is what one of us (Tononi) and colleagues showed in a breakthrough study published in 2011. In the brain of sleep-deprived, awake rats, isolated groups of neurons briefly ceased firing, a phenomenon that increased with the amount of sleep deprivation. Working with researchers at the University of California, Los Angeles, they also reported that same year that when humans sleep, some parts of the brain can be observed behaving as if they are already awake, especially toward the end of the night.

Because we can identify the brain regions involved in sleep disorders, these conditions provide an excellent case study for clarifying how the brain creates an integrated conscious experience. The discoveries being made in sleep violence may have moral, ethical and legal implications that society has barely begun to recognize. M

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IN SEARCH OF Charisma

Heads of state, chief executives and other leaders are not born with the power to inspire. They manufacture this magic dust in partnership with their followers

BY S. ALEXANDER HASLAM AND STEPHEN D. REICHER

Illustration by Josue Evilla

The President pulled himself up the long ramp to the platform of his railway car.... Friend or foe, those who saw him at this moment could not help being moved at the sight of this severely crippled man making his way up with such great difficulty—really propelling himself along by his arm and shoulder muscles as his strong hands grasped the rails at the side of the ramp.

Franklin D. Roosevelt's whistle-stop train tours in the presidential campaigns of 1932 and 1936, as described here by his speechwriter Samuel Rosenman, have become the stuff of legend. By any measure, they were highly successful. According to Breckinridge Long, Roosevelt's ambassador to Italy, the crowds who flocked to see him "passed any bounds for enthusiasm—really wild enthusiasm—that I have ever seen in any political gathering." This gusto spilled over to the ballot box, and in 1936 Roosevelt won the election by 11 million votes, taking every state bar Vermont and Maine. A range of academic studies, most notably an influential analysis by Dean Keith Simonton of the University of California, Davis, published in 1988 in the *Journal of Personality and Social Psychology,* identify Roosevelt as the most charismatic of all U.S. presidents.

At first, Roosevelt's advisers counseled him against the tours that were to cement his reputation. In 1921 Roosevelt had been diagnosed with polio or "infantile paralysis," as it was

then popularly called. As political campaigns expert Kathleen Hall Jamieson of the University of Pennsylvania has vividly documented, for much of human history effective and charismatic leaders have been depicted as virile, robust and energetic. Roosevelt's "infantile" state robbed him of all that.

What, then, was the source of his charisma? Numerous scholars suggest that he derived it by artfully turning his disadvantage into an advantage. He shifted the focus from the negative qualities of his condition to the positive attributes of his personal conquest—courage, endurance and effort. Doing so allowed him to connect personally with the suffering of millions of ordinary Americans during the Great Depression. After he died, a reporter asked one of the mourners waiting to see his funeral train at Washington's Union Station, "Why are you here? Did you know Franklin Roosevelt?" The mourner is said to have replied, "No, but he knew me."

Roosevelt managed to appear to be both "of us" and "for us," a feat that lies at the heart of charisma in general. Rather than a gift endowed from birth, charisma is the outcome of careful craftsmanship. In this process, the group being led is on equal footing with the leader. The aspiring politician, business executive or activist must integrate the group's history, hopes and values into a coherent story—in Roosevelt's case, it was centered on perseverance—and cast himself or herself as emblematic of that narrative.

Franklin Roosevelt managed to appear to be both "of us" and "for us," a feat that lies at the heart of charisma in general.

A delicate balance of social forces imbues a person with the ability to inspire. When watching the stagecraft of an election, observe the candidates' efforts to lodge their interpretations of group identity in the minds of voters. Politics is just one domain, however. Recent findings suggest we all can learn to cultivate our own charisma. Whether as a politician, a Fortune 500 CEO or an aspiring student body president, we can shine a little brighter by understanding how groups think.

Born or Made?

In Greek, the word "charisma" (χάρισμα) has multiple meanings: the power to perform miracles, the ability to make prophecies and the capacity to influence others. The last meaning is most relevant here because leadership is now commonly defined as a social process, as opposed to a trait, that enables a person to motivate others to help achieve group goals.

Leadership and charisma were not always viewed as social phenomena. Since the first writings on the subject around 2,400 years ago, most scholars have considered the qualities of leadership to be possessed at birth by a select few. Socrates declared that "only a tiny number of people" have the breadth of vision and the physical and mental gifts required to preside over their fellow citizens. More recently, this position has been attributed to German sociologist Max Weber, the person generally credited with popularizing the term "charisma." Early in the 20th century he described charisma as:

> A certain quality of an individual personality by which [a leader] is set apart from ordinary men and treated as endowed with superhuman or at least specifically exceptional powers or qualities. These are such as are not accessible to the ordinary person, but are regarded as of divine origin or as exemplary … as resting on magical powers.

Read more closely, however, and it becomes clear that Weber did not see charisma as merely a rare quality possessed by certain lucky individuals.

FAST FACTS

Crafting Charisma

1» **Charisma was traditionally thought to be an attribute of the leader, but it is primarily an attribution made by followers.**

2» **Charisma centers on the capacity for a leader to be seen by followers as advancing group interests. Its spell can be broken if leaders are discovered to be acting for themselves or for an opposing group.**

3» **Charismatic leaders cultivate narratives in which their sense of self comes to be seen by followers as emblematic of their shared group identity.**

We are not born with a natural talent for winning hearts and minds. Followers respond to a leader's thoughtfully tuned public identity by endowing that person with charisma.

People tend to focus on the words "superhuman" and "magical" in the above quotation, but the words "treated" and "regarded" are equally important. As Weber continues: "What is alone important is how the individual is regarded by those subjected to charismatic authority, by his 'followers' or 'disciples.'" In other words, followers distinguish the leader from others and *confer* charisma on him or her.

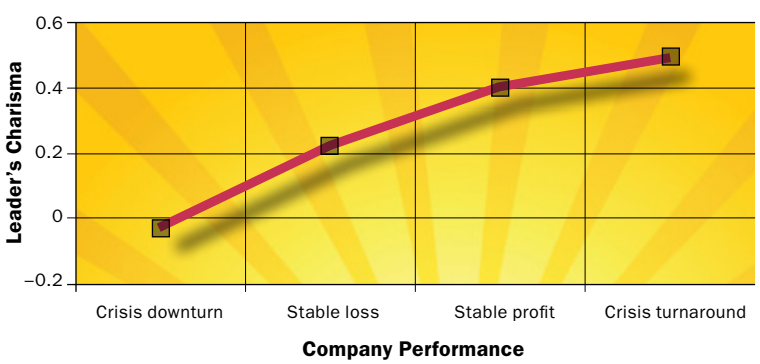
Empirical research supports this insight, in particular work by the late James Meindl of the University at Buffalo S.U.N.Y. and his colleagues. Meindl, along with Sanford Ehrlich, now affiliated with U.C. San Diego, and Janet Dukerich of the University of Texas at Austin, reviewed 30,000 newspaper reports that mentioned business executives' leadership. In 1985 they reported a strong correlation between references to charismatic leadership and evidence that a company's performance had improved. The discovery suggested two possibilities: either a leader's decisions and actions led to organizational improvement, or when people saw a company perform better, they assumed the outcome was because of charismatic leadership.

To tease out the thorny issues of causality, Meindl designed a follow-up experiment. Working with Rajnandini Pillai of California State University San Marcos, he presented business school students with biographical information about the male chief executive of a fast food company along with data about the company's performance during the preceding 10 years. Some study participants were told that the company had gone from a profit into loss (a "crisis decline"), whereas others were told that the business had remained in a loss, maintained a profit or gone from a loss to profit (a "crisis turnaround"). The participants then rated the leader's charisma on a series of scales [*see box below*].

Although the executive's character was described the same way in each condition, he was seen as much more charismatic when the company's fortunes had improved. As a result, Meindl concluded that charisma is not a characteristic of a leader but an attribution made by followers who are seduced

To Love or to Loathe

An experiment by Rajnandini Pillai and James Meindl shows that charisma is not part of a person's character. Judgments of a CEO's charisma depended not on the individual, who stayed the same throughout, but on the company's fortunes. The more successful the group, the more charismatic the leader was seen to be.



GETTY IMAGES (*top*); SCIENTIFIC AMERICAN MIND (*bottom*)

by what he termed "the romance of leadership." In short, charisma may be more a trap than a trait.

There is more to seeing charisma, however, than observing success. Evidence from other research suggests that we are unlikely to attribute charisma to the manager of a competing team that outperforms ours or to the leader of a rival party that defeats our own at the polls. That is, a leader succeeds for *us*. This insight is the starting point for what we, in a 2010 book co-authored with Michael J. Platow of the Australian National University, refer to in the title as *The New Psychology of Leadership* [see also our article by that name in Scientific American Mind, August/September 2007].

> A charismatic leader is an entrepreneur of identity. This person clarifies what we believe **rather than telling people what they believe.**

Making "Us" Special

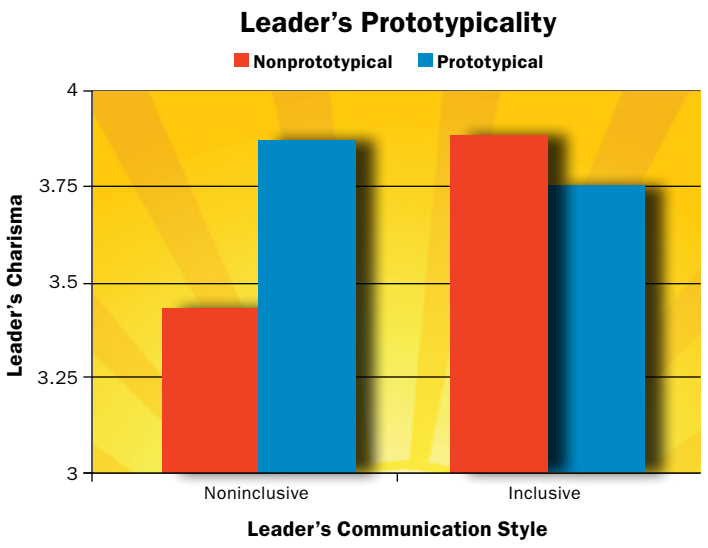
The framework for our analysis comes from the work of the late John C. Turner, who was a social psychologist at the Australian National University. Turner's key insight into leadership, elaborated in his 1991 book *Social Influence,* is that it is a group process in which individuals' sense of a shared social identity enables them to exert influence over one another.

Social identity refers to people's understanding of themselves as belonging to a group. It is the sense of "us-ness" that we recognize when we refer to "us Americans," "us students," "us Celtics fans," and so on. A significant prediction of social identity theory is that when we define ourselves in terms of a group (for example, "us Americans"), we then view that collective as different from, and better than, other groups. If a group matters to us, it hurts to see it confused with others, as you will know if you are a Canadian who has mistakenly been called an American or a Scot who has been taken for an Englishman. Similarly, it pains us to see our group get beaten—particularly by a rival group.

We also tend to recognize other members of our group as more helpful than outsiders in advancing our group's interests. An ongoing research program by psychologist Daan van Knippenberg of Erasmus University Rotterdam and his colleagues Nathalie Lossie and Henk Wilke has shown that regardless of the particular arguments leaders put forward for a new policy—such as whether they favored or opposed university entrance exams—students are influenced more by those leaders whose views appeared representative of the student body than by those whose opinions were thought to be unrepresentative. In other

Power to the Prototypical

Being one of the gang makes it easier to lead with verve, but there are other ways to dazzle. Michael J. Platow of the Australian National University and his colleagues gave study participants information indicating that a student leader was either representative or not of the student body. The subjects then read a message from "Chris" and indicated how charismatic they thought he was on a scale of 1 to 7. As this graph indicates, Chris was seen as more charismatic when he was prototypical of the student in-group, but if he was nonprototypical his charisma increased when his message used inclusive language that emphasized shared social identity.



SCIENTIFIC AMERICAN MIND

Charismatic Presidents

The inaugural addresses of Franklin D. Roosevelt and John F. Kennedy in many ways epitomize their respective presidencies and charisma. Each speech tells a story about American identity for which the president is prototypical. F.D.R.'s narrative is about fighting and overcoming a frightening paralysis; J.F.K. spins a tale about youth, freshness and liberalism. In neither case was this identity—or the charisma that flowed from it—self-evident. Rather it had to be carefully constructed and managed to win over followers.

This great Nation will endure as it has endured, will revive and will prosper. So, first of all, let me assert my firm belief that the only thing we have to fear is fear itself—nameless, unreasoning, unjustified terror which paralyzes needed efforts to convert retreat into advance. In every dark hour of our national life a leadership of frankness and vigor has met with that understanding and support of the people themselves which is essential to victory.
—1933

Let the word go forth from this time and place, to friend and foe alike, that the torch has been passed to a new generation of Americans, born in this century, tempered by war, disciplined by a hard and bitter peace, proud of our ancient heritage, and unwilling to witness or permit the slow undoing of those human rights to which this Nation has always been committed, and to which we are committed today at home and around the world.
—1961

GETTY IMAGES (*F.D.R.*); ALFRED EISENSTAEDT *Getty Images* (*J.F.K.*)

words, to trust leaders to take us in the right direction, we need first to believe that they are "one of us."

The same principles underlie perceptions of charisma. For example, in a recent experiment we conducted with Kim Peters and Niklas Steffens of the University of Exeter in England and presented at the 2011 General Meeting of the European Association of Social Psychology, we found that students perceived President Barack Obama's address to the 2009 Copenhagen Climate Change Summit to be charismatic when they saw him as a member of their group and advancing its goals. More specifically, respondents who defined themselves as "environmentalists" judged Obama's speech as more charismatic when they were told that the U.S. was going to meet targets for carbon dioxide emissions reduction than when they were led to believe the U.S. would miss those goals. This information, however, had no impact on the students who did not define themselves as environmentalists, who generally saw the speech as far less charismatic. Obama's charisma was contingent on his audience members perceiving that he supported their goals.

A number of other studies that we and our colleagues have conducted confirm this result. These experiments all ask university students to rate the charisma of "Chris," a student leader. They do so by evaluating statements that ask them to assess to what degree Chris, as a leader, inspires loyalty, has a vision that spurs people, increases group optimism for the future, and the like.

The participants are told that Chris has various attributes—intellectual, serious or friendly, easygoing, and so forth—that are either typical, or not, of the student body as a whole. He also either succeeds or fails to advance the position of the student union. As Pillai and Meindl had shown in their studies on people's views of CEOs, the results of these experi-

(The Authors)

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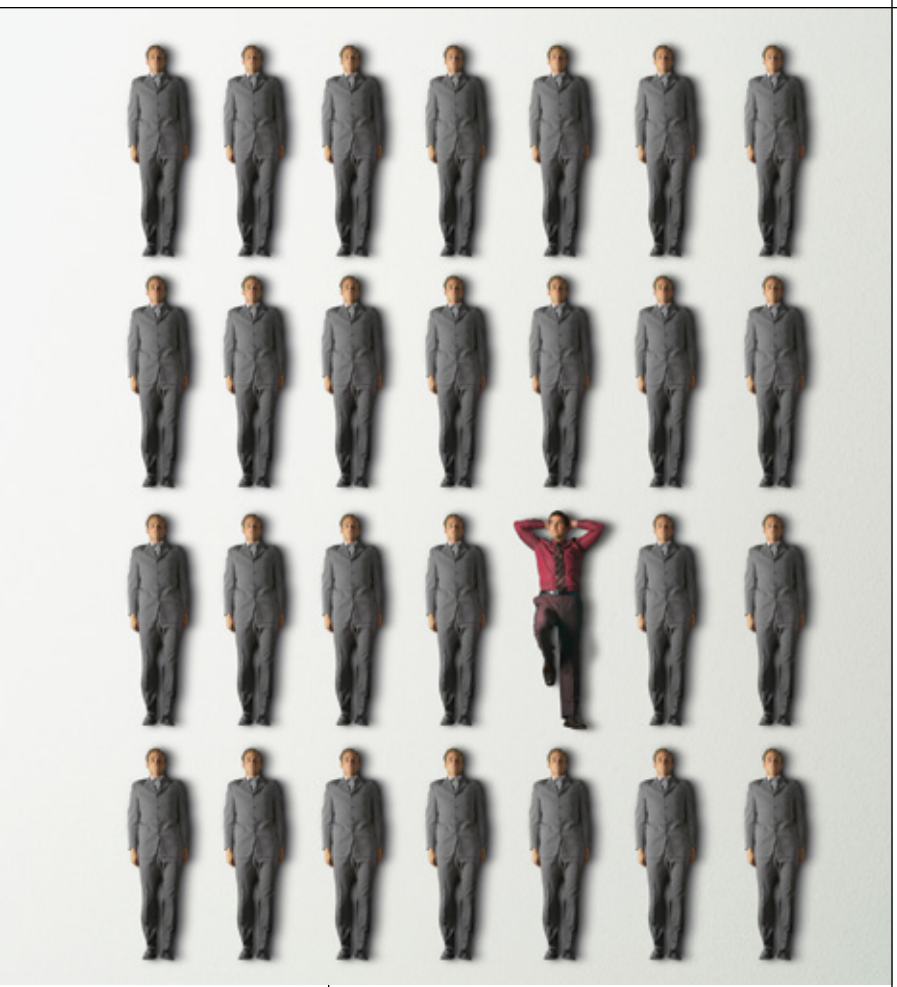

Appearing prototypical improves ratings of charisma. A leader who zigs when others zag, however, can shore up his or her charisma by using words such as "us" and "we" that emphasize a shared identity.

ments again indicate that success contributes to charisma. Yet they also underscore the importance of prototypicality. When the union prospers but Chris is thought to be unrepresentative of the student body, respondents rated him as no more charismatic than when the union declined but he was seen as more typical.

If the leader's views do not align with the group, those in charge are not necessarily doomed, however. A study by Platow and his colleagues in 2006 showed that leaders can regain charisma by using language that establishes a sense of shared identity—referring to "us" and "we" rather than "me" and "I." Chris was seen as more charismatic when he was thought to be similar to other students, but if he was nonprototypical his charisma increased when his message used inclusive language that emphasized shared social identity [*see box on page 46*].

Tell Us Our Story

The larger point here is that prototypicality—and thus charisma—is not something that we either possess or lack. Rather it is something we can actively construct. For many years we have been examining how effective leaders craft narratives of themselves, their proposals and the groups to which they appeal. In the 2001 book *Self and Nation,* by one of us (Reicher) and Nick Hopkins of the University of Dundee in Scotland, we used a phrase to summarize this notion: leaders, and charismatic leaders in particular, need to be skilled "entrepreneurs of identity." Ultimately the charismatic leader is one who is seen as clarifying what "we" believe rather than telling people what they believe. Further, the art of charisma involves concealing the craft involved. To declare bluntly "this is who we are" invites the response "oh no we are not!" Successful narratives of identity unfold as a revelation rather than an edict.

Different prescriptions for the group, however, demand different forms of embodiment. Consider another charismatic president of modern times, John F. Kennedy (who came in fourth in Simonton's ranking). Kennedy, like Roosevelt, suffered from a debilitating condition. In his youth he was diagnosed with Addison's disease, which contributed to the deterioration of his back and put him in almost constant pain. Injuries he suffered while serving as a torpedo-boat commander in World War II exacerbated his condition. Whereas Roosevelt displayed his disability to embed a narrative of "overcoming,"' no such option was open to Kennedy. He envisioned America as a young, virile and energetic nation casting off the conservatism and dourness of the past—a dourness personified, he suggested, by his rival, Richard M. Nixon. Only a few days before his famous inaugural address, his face puffed up because of the cortisone that he was taking to combat his Addison's, he exclaimed to his secretary that "if I don't lose five pounds this week we might have to call off the inauguration." Yet on that cold January day in Washington, Kennedy looked lean and radiant, one of the few to remain hatless, displaying his luxuriant head of hair. Here was a man who could embody what his words proclaimed: a new generation [*see box on preceding page*].

CJ BURTON *Corbis (top);* GETTY IMAGES *(bottom)*

Roosevelt and Kennedy understood the need for fusing appearances with identity narratives, but others were not quite so insightful. David Gergen, an adviser to four presidents, relates how Nixon once paid a state visit to Charles de Gaulle at the Elysée Palace. Nixon was so impressed by the presidential guards' regal

uniforms, with their braids and epaulettes, that he tasked his staff with procuring similar uniforms for the White House security staff. When the guards first wore the outfits, however, the reporters who saw them laughed so uproariously that the uniforms were immediately donated to a college marching band. Nixon had failed to appreciate that French and American traditions are very different: what signals prestige in one context provokes ridicule in another.

Many leaders famed for their charisma had a keen interest in poetry and the craft of language—this is no coincidence.

How to Gain Charisma

A person who aspires to lead—whether in a political or corporate context or even on a sports team—can follow guidelines to bolster their charisma. We suggest that the answer lies in what we term "the three Rs" of effective leadership: reflecting, representing and realizing. We sketch out these principles here; however, a priority for future research is to figure out exactly how to implement them in everyday practice.

"Reflecting" refers to the need to learn about the culture and history of a group. You might study the writings through which identity has been expressed in the past—for example, the Declaration of Independence, the poems everyone reads at school or scriptural texts that underpin shared values. Many leaders famed for their charisma had a keen interest in poetry and the craft of language—this is no coincidence. Similarly, numerous great leaders also spent a long time listening before they emerged to speak for the collective. In our own work, we have found that those who believe from the outset that they have "the right stuff" of leadership and have nothing to learn from others are rarely chosen as good leaders. Equally, we have documented the common tragedy of leadership: even if they listen at first, successful leaders easily succumb to the view that their achievements are entirely their own, and over time they become less willing to listen to others. This spells downfall, and ultimately they are rejected for no longer speaking for us.

"Representing" refers to the need to be seen as both a member and proponent of the group. A leader not only weaves a narrative around her identity, her proposals and the group she is addressing, she must also make all these stories coherent and consistent. Appearance, tone of voice and word selection all play a role. The lack of formal elegance in Ronald Reagan's rhetoric, and even the misspeaking of George W. Bush, so beloved of satirists, served to sustain rather than sabotage these presidents, positioning their critics as out-of-touch elitists. When Reagan was asked what voters saw in him, he responded astutely, "I think, maybe, they see themselves and that I'm one of them." Finally, as with good writing and acting and so much else, representing is about leading the audience to draw the conclusions one desires rather than having to spell out those ideas for them. The art of charisma, then, is to appear artless.

Finally, "realizing" is about turning the things we value in principle into realities. A leader's success is measured by how well that person pursues the top priorities of the group, for example, economic growth, equality or international prestige. A leader who shines with the sparkle of charisma will also help shape those criteria and mobilize people in their favor. A winsome, successful president must negotiate the press, work the political system and pass legislation. In short, charismatic leaders are those who succeed in making us matter.

To an extent, charismatic leaders are also lucky leaders. On being asked what he feared most, British prime minister Harold Macmillan famously remarked: "Events, dear boy, events." A skilled entrepreneur of identity, however, can still make the best of long odds. Sheer bad luck led Roosevelt to lose the use of his legs. Years of sweat and toil allowed him to walk despite his affliction. Years of toil and craft allowed him to turn what many viewed as a liability into his greatest electoral asset. M

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Is Your Child Gay?

If your son likes sissy stuff or your daughter shuns feminine frocks, he or she is more likely to buck the heterosexual norm. But predicting sexual preference is still an inexact science

By Jesse Bering

FAST FACTS
Trading Places

1» **Both lesbians and gay men often have a history of cross-sex-typed behaviors: little boys becoming infatuated with their mother's makeup kit; little girls enamored of field hockey or professional wrestling.**

2» **Prehomosexual boys tend to be more attracted to solitary sports such as swimming, cycling and tennis than they are to rougher contact sports such as football and soccer.**

3» **Children who show pronounced sex-atypical behaviors may have more of a genetic loading to their homosexuality.**

We all know the stereotypes: an unusually light, delicate, effeminate air in a little boy's step, an interest in dolls, makeup, princesses and dresses, and a strong distaste for rough play with other boys. In little girls, there is the outwardly boyish stance, perhaps a penchant for tools, a square-jawed readiness for physical tussles with boys, and an aversion to all the perfumed, delicate trappings of femininity.

These behavioral patterns are feared, loathed and often spoken of directly as harbingers of adult homosexuality. It is only relatively recently, however, that developmental scientists have conducted controlled studies to identify the earliest and most reliable signs of adult homosexuality. In looking carefully at the childhoods of gay adults, researchers are finding an intriguing set of behavioral indicators that homosexuals seem to have in common. Curiously enough, the age-old homophobic fears of many parents reflect some genuine predictive currency.

J. Michael Bailey and Kenneth J. Zucker, both psychologists, published a seminal paper on childhood markers of homosexuality in 1995. Bailey and Zucker examined sex-typed behavior—that long, now scientifically canonical list of innate sex differences in the behaviors of young males versus young females. In innumerable studies, scientists have documented that these sex differences are largely impervious to learning. They are also found in every culture examined. Of course, there are exceptions to the rule; it is only when comparing the aggregate data that sex differences leap into the stratosphere of statistical significance.

The most salient differences are in

GETTY IMAGES

the domain of play. Boys engage in what developmental psychologists refer to as "rough-and-tumble play." Girls prefer the company of dolls to a knee in the ribs. Toy interests are another key sex difference, with boys gravitating toward toy machine guns and monster trucks and girls orienting toward baby dolls and hyperfeminized figurines. Young children of both sexes enjoy pretend play, but the roles within the fantasy context are gender-segregated by age two. Girls enact the role of, say, cooing mothers, ballerinas or fairy princesses, and boys prefer to be soldiers and superheroes. Not surprisingly, therefore, boys naturally select other boys for playmates, and girls would much rather play with other girls.

So on the basis of some earlier, shakier research, along with a good dose of common sense, Bailey and Zucker hypothesized that homosexuals would show an inverted pattern of sex-typed childhood behaviors—little boys preferring girls as playmates and becoming infatuated with their mother's makeup kit; little girls strangely enamored of field hockey or professional wrestling—that sort of thing. Empirically, the authors explain, there are two ways to investigate this hypothesis, with either a prospective or retrospective study. Using the prospective method, young children displaying sex-atypical patterns are followed into adolescence and early adulthood so that their sexual orientation can be assessed at maturity.

This method is not terribly practical for several reasons. Given that a small proportion of the population is homosexual, prospective studies require a large number of children. This approach also takes a long time, around 16 years. Finally, not a lot of parents are likely to volunteer their children. Right or wrong, this is a sensitive topic, and usually it is only children who present significant sex-atypical behaviors who are brought into

Not all tomboys become lesbians, of course. But tough girls may be more likely than little ladies to prefer same-sex partners as adults.

NORBERT SCHAEFER *Corbis*

clinics and whose cases are made available to researchers.

Rough-and-Tumble Girls

For example, in a 2008 study psychologist Kelley Drummond and her colleagues interviewed 25 adult women who were referred by their parents for assessment at a mental health clinic when they were between three and 12 years old. At the time, all these girls had several diagnostic indicators of gender identity disorder. They might have strongly preferred male playmates, insisted on wearing boys' clothing, favored rough-and-tumble play, stated that they would eventually grow a penis or refused to urinate in a sitting position. Although only 12 percent of these women grew up to be gender dysphoric (the uncomfortable sense that your biological sex does not match your gender), the odds of these women reporting a bisexual or homosexual orientation were up to 23 times higher than would occur in a general sample of young women. Not all tomboys become lesbians, of course, but these data suggest that lesbians often have a history of cross-sex-typed behaviors.

And the same holds for gay men. Bailey and Zucker, who conducted a retrospective study in which adults answered questions about their past, revealed that 89 percent of randomly sampled gay men recalled cross-sex-typed childhood behaviors exceeding the heterosexual median.

Critics have argued that participants' memories may be distorted to fit with societal expectations and stereotypes. But in a clever study published in 2008 in *Developmental Psychology,* evidence from childhood home videos validated this retrospective method. People blindly coded child targets on the latter's sex-typical behaviors, as shown on the screen. The authors found that "those targets who, as adults, identified themselves as homosexual were judged to be gender nonconforming as children."

Numerous studies have since replicated this general pattern, revealing a strong link between childhood deviations from gender role norms and adult sexual orientation. There is also evidence of a "dosage effect": the more gender-nonconforming characteristics there are in childhood, the more likely it is that a homosexual or bisexual orientation will be present in adulthood.

Not all little boys who like to wear dresses grow up to be gay, nor do all little girls who despise dresses become lesbians. Many will be straight, and some, let's not forget, will be transsexuals. I was rather androgynous, showing a mosaic pattern of sex-typical and atypical behaviors. In spite of my parents' preferred theory that I was simply a young Casanova, Zucker and Bailey's findings may account for that old Polaroid snapshot in which 11 of the 13 other children at my seventh birthday party are little girls. But I wasn't an overly effeminate child, was never bullied as a "sissy" and, by the time I was 10, was indistinguishably as annoying, uncouth and wired as my close male peers.

On the Monkey Bars

In fact, by age 13, I was deeply socialized into masculine norms. I took to middle school wrestling as a rather scrawny 80-pound eighth grader, and in so doing, ironically became all too conscious of my homosexual orientation.

Cross-cultural data show that pre-homosexual boys are more attracted to solitary sports such as swimming, cycling and tennis than they are to rougher contact sports such as football and soccer; they are also less likely to be childhood bullies. In any event, I distinctly recall being with the girls on the monkey bars during recess in second grade while the boys were in the field playing football and looking over at them, thinking to myself how that was rather strange. I won-

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By age 13, I was deeply socialized into masculine norms. I took to middle school wrestling and, in so doing, ironically became all too conscious of my homosexual orientation.

HEIDE BENSER *Corbis*

Does junior's attraction to Mom's high heels mean he will be gay? No. But gay guys are more likely than straight ones to have donned feminine costumes as kids.

dered why anyone would want to act that way.

Researchers readily concede that there are quite likely multiple—and no doubt extremely complicated—developmental routes to adult homosexuality. Heritable, biological factors interact with environmental experiences to produce sexual orientation. Because the data often reveal very early emerging traits in prehomosexuals, children who show pronounced sex-atypical behaviors may have more of a genetic loading to their homosexuality, whereas gay adults who were sex-typical as children might trace their homosexuality more directly to particular childhood experiences.

Then we arrive at the most important question of all. Why do parents worry so much about whether their child may or may not be gay? All else being equal, I suspect we would be hard-pressed to find parents who would actually prefer their offspring to be homosexual. Evolutionarily, parental homophobia is a no-brainer: gay sons and lesbian daughters are not likely to reproduce (unless they get creative).

But bear this in mind, parents, there are other ways for your child to contribute to your overall genetic success than humdrum sexual reproduction. I don't know how much money or residual fame is trickling down to, say, k. d. lang, Elton John and Rachel Maddow's close relatives, but I can only imagine that these straight kin are far better off in terms of their own reproductive opportunities than they would be without a homosexual dangling so magnificently on their family trees. So cultivate your little prehomosexual's native talents, and your ultimate genetic payoff could, strangely enough, be even larger with one very special gay child than it would be if 10 mediocre straight offspring leaped from your loins.

If researchers eventually perfect the forecasting of adult sexual orientation in children, would parents want to know? I can say as a once prehomosexual pipsqueak that some preparation on the part of others would have made it easier on me, rather than constantly fearing rejection or worrying about some careless slipup leading to my "exposure." It would have at least avoided all those awkward, incessant questions during my teenage years about why I wasn't dating a nice pretty girl (or questions from the nice pretty girl about why I was dating her and rejecting her advances).

And another thing: it must be pretty hard to look into your prehomosexual toddler's limpid eyes, brush away the cookie crumbs from her cheek and toss her out on the streets for being gay. M

Excerpted from Why Is the Penis Shaped Like That? … And Other Reflections on Being Human, *by Jesse Bering, by arrangement with Scientific American/Farrar, Straus and Giroux, LLC (North America), Transworld Ltd (UK), Jorge Zahara Editora Ltda (Brazil).*

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You only live twice: once when you are born, and once when you look death in the face. —*Ian Fleming*

Mortal Thoughts

We run from the subject like there's no tomorrow, but thinking about death can ease our angst and make us better people, too

By Michael W. Wiederman

My father was just 32 years old when he was diagnosed with acute leukemia. Weeks later he was in the hospital, informed that he would not be leaving. Miraculously the leukemia went into remission, and he lived another five years. Even as a child, though, I could clearly see that the man who returned from the hospital was not the same one who had left home. Before, he had been concerned mostly with work and material success; now he embraced religion and family. Getting a second, tenuous chance at life was a profound experience that deeply changed his values and behavior.

ISTOCKPHOTO (*leaf*); DUANE RIEDER Getty Images (*man holding leaf*)

Remembering that I'll be dead soon is the most important tool I've ever encountered to help me make the big choices in life. —*Steve Jobs*

There is no cure for death, save to enjoy the interval. —*George Santayana*

JOE BARAN *Getty Images*

FUTURE SHOCK: A close brush with death or the death of a loved one can prompt us to reassess our lives.

We deflect it with humor, hedge against it with good works, shun reminders of our animal nature. Yet we all share the reality of mortality, and we know it, try as we might to throttle our thoughts about it. Indeed, this simultaneous knowing and recoiling from our knowledge is a tension that will run throughout our life. Yet despite the significance of the subject, for most of its history psychology has left the matter of how mortal thoughts affect us almost completely unexplored—terror incognita.

That neglect appears to be a thing of the past. In recent years researchers have begun to find that awareness of mortality affects our behavior in ways both overt and subtle and sometimes seems to pull us in opposite directions. Therapists who take an existential approach to counseling have found that confrontation with our mortality is worthwhile and beneficial. At the same time, a new discipline called Terror Management Theory (TMT) has spawned hundreds of studies showing that awareness of our mortality can lead to selfish, even hurtful behavior.

More recently, this apparent disagreement among different disciplines, common enough in new fields of research, has given way to a deeper understanding of why our thoughts about mortality sometimes help us and sometimes do us harm. One essential determinant of how we handle the subject appears to be whether our life goals are material or ide-

FAST FACTS

Making Sense of Mortality

1» **Awareness of our mortality has different effects depending on whether the awareness is conscious and reflective or subconscious and fleeting. Prolonged contemplation of death produces shifts in personal values and goals.**

2» **Terror Management Theory proposes that we unconsciously fend off thoughts of our mortality by investing in our culture as a symbolic way of attaining some degree of immortality.**

3» **A large body of research has shown that subconscious awareness of mortality prompts people to defend their worldviews, even in ways that may be harmful.**

alistic. The effect of mortal thinking on behavior also seems to depend on whether death is at the top of our mind or hovering just beyond our consciousness. Still, the duality of helpful and harmful effects echoes one of life's central conundrums: we cannot deny that someday we will die, so how are we to keep this paralyzing truth from paralyzing us?

Facing Death Head-on

In one of my favorite cartoons, by Eric Lewis, a man lying on his deathbed says to his attentive wife, "I should have bought more crap." The dying man's regret is a tour de force of deflection and misdirection, the opposite of what we expect of a man looking back with rue. For most of us, a near-death experience or the death of someone we know prompts us to take stock of our life in a good way. This certainly was true for my father, and it is precisely the effect that existential therapists count on as they try to help their clients confront mortality and shift their life onto a more meaningful path. Typically the shift is from extrinsic values and goals, such as material success, toward intrinsic ones, such as matters of the soul or spirit.

Surveys validate the usefulness of the approach. In a study published in 2007 Emily L. B. Lykins of the University of Kentucky and her colleagues questioned staff at a medical center in Northridge, Calif., two to three weeks after an earthquake devastated the surrounding area, killing 57 and injuring thousands more. The staff were asked to rate the importance of 16 different goals both currently and as they were before the earthquake. The results indicated a shift in values toward intrinsic goals such as cultivating close relationships, doing creative work and developing as a person. Moreover, those respondents who had most strongly feared they were going to die in the earthquake were also most likely to indicate a shift from extrinsic to intrinsic goals.

The beneficial effect works the other way around, too. People who pursue intrinsic goals have more success in heading off anxiety associated with death than those who chase material things. In 2009 Alain Van Hiel and Maarten Vansteenkiste of Ghent University in Belgium published their survey of older adults (with an average age of 75). The elders who reported having fulfilled more of their intrinsic goals were the least anxious about death and most satisfied with their life. In contrast, respondents who reported the greatest attainment of extrinsic goals indicated the most despair and the least acceptance of death.

Intrinsic life goals and the creation of meaning appear to be central to coping with our mortality. William S. Breitbart and several colleagues at Memorial Sloan-Kettering Cancer Center in New York City recently published the results of an intervention with patients coping with advanced stages of cancer. The patients were randomly invited to participate in one of two groups that met once a week for eight weeks. The first group, which focused on social support, facilitated discussions about day-to-day concerns and ways to cope with them. The second group focused on the sources of meaning in life. At the end of the eight weeks and again at a two-month follow-up, members of the group focused on meaning in life showed substantial increases in their scores on measures of meaning, peace and faith, along with decreases in anxiety and desire for death. The members of the group focused on social support showed no statistically significant changes.

Taming Terror

These surveys suggest that people who have an abrupt encounter with mortality tend to seek meaning in life, and those who pursue meaning in life can handle mortality more easily. People also seem to use systems of meaning to block awareness of their mortality, clinging to aspects of their life that provide connection with social structures.

How this protective shield might work is the focus of the burgeoning field of Terror Management Theory. Based on the writings of cultural anthropologist Ernest Becker in the 1960s and 1970s and the more recent work of psychologists Jeff Greenberg of the University of Arizona, Tom Pyszczynski of the University of Colorado and Sheldon Solomon of Skidmore College, TMT proposes that we humans maintain a shared culture because social roles and consequences for behavior keep us busy and so insulate us from the existential terror of our impermanence.

Interesting as such propositions are, they leave unanswered the question of whether our thoughts of mortality are what spur us to defend our culture and

GARY JOHN NORMAN Getty Images

NEXT GEN: Parenthood provides us with a sense of purpose and symbolic immortality that can help stave off existential angst.

The only way I expect to have some version of immortality is through my books. —*Isaac Asimov*

I don't want to achieve immortality through my work ... I want to achieve it through my not dying. —*Woody Allen*

BRAD WILSON *Getty Images*

SPIRIT: Religion can temper fear of mortality by providing believers with a strong sense of purpose and by giving death a context so that it no longer seems a great unknown.

bolster our self-esteem or whether we just do what we do because it feels right. Psychologists needed a new approach to tease out how our mortal thoughts influence us.

Death in the Laboratory

Imagine you are staying with a friend who lives on the 20th floor of an old apartment building. It's the middle of the night. You are awakened from a deep sleep by the sound of screams and the choking smell of smoke. You run to the door and reach for the handle. You pull back in pain as the intense heat of the knob burns your skin. You grab a blanket from the bed for protection and manage to open the door. Almost immediately, a huge wall of flame and smoke roars into the room. It is getting very hard to breathe, and the heat from the flames is almost unbearable. You try calling out for help, but you can't find the air to form the words. With your heart pounding, it suddenly hits you that you are moments from dying. Out of breath and weak, you shut your eyes and wait for the end.

Fun thought exercise, yes? It is drawn from a 2003 study by Philip J. Cozzolino, now at the University of Essex in England, and his colleagues. Contemplating scenarios like it is how volunteers in some of the 300 or so TMT studies conducted during the past two decades were primed (and terrified) before they were put through their paces by researchers trying to see how reflection about death can affect human behavior.

Most TMT research focuses on the so-called mortality salience hypothesis: if investment in our culture and self-esteem serves to fend off our sense of mortality, then stimulating our awareness of mortality should increase investment in our culture and self-esteem. Researchers can arouse mortality salience in a variety of ways, but in most studies, participants are asked to write essays in which they imagine either death or some other kind of pain.

One group might be asked to visualize a scenario akin to the one above and to describe both what would happen to them physically as they died and the feelings kindled in them by thinking about their death. The control group might be asked to imagine and describe a less terminally uncomfortable event, such as an episode of dental pain or an experience of social exclusion. Then the researchers attempt to assess how the two groups differ in their self-esteem and their willingness to invest in their culture.

(The Author)

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Researchers learned that when thoughts of death reverberate too loudly, they can drown out subtle but important changes in our behavior. When we are made to concentrate on our mortality, we tend to defend against anxiety by direct means, primarily denial, rationalization and a focus on the positive aspects of our life, boosting our sense of well-being by converting death into an abstraction that lies in the far future. Thus, if scientists measure investment in worldview or self-esteem immediately after increases in awareness of mortality (as with the group writing about death by fire), usually they see no apparent effects. The relations appear only when respondents are distracted after their awareness is heightened.

In a typical study, after completing the death essay (or the control essay), participants perform a filler task having nothing to do with death so that any unconscious defenses against mortality awareness have a chance to emerge. Only then comes a measurement of the participants' investment in their culture or self-esteem. Within this framework, researchers began to see that our mortality affects us in ways we do not even realize, especially in how it can transform our goals.

Religiosity and Creatureliness

Because religion is such an important aspect of our worldview (not least whether we are pro or con), it makes an especially useful starting point for researchers. Religious teachings tend to explain what happens to believers and nonbelievers after death, so defending one's religious beliefs in the face of mortality is particularly common. Yet a series of studies reported in 2006 by Ara Norenzayan and Ian G. Hansen, psychologists at the University of British Columbia, showed that thoughts of death did more than make people with religious dispositions think of eternity at the right hand of God.

In the first of their studies, college students randomly assigned to write the standard death essay rated themselves about 30 percent higher on measures of religiosity and belief in God than did students assigned to write the control essay. What the experiment did not reveal was whether thoughts of death simply reminded people of their religious belief or prodded them to bolster their religiosity as a defense against mortality. To investigate this possibility, the second study randomly exposed college students to one of three versions of a brief story about a boy's visit to a hospital. All versions started and ended the same, but the middle passages differed. In the control version, the boy watched an emergency drill carried out by adults, in the religious version the boy observed a man praying in the hospital chapel, and in the death version the boy had an accident and died.

One of the distraction tasks in the experiment called for students to read a report of a study illustrating apparent effects of Christian prayer by strangers on the reproductive rates of women attending a fertility clinic. As part of their assessments of the study, participants were asked to rate their belief in God or in a higher power. The ratings by students in the control condition and religious condition did not differ, but both were significantly lower than the ratings by those in the death condition. It seems that mortality salience uniquely motivates people to bolster their religious beliefs.

Besides giving us a context for spirituality, culture also helps to protect us from thoughts of mortality through norms and customs that let us forget we are animals, which we know are mortal and die for capricious reasons. For example, elimination of bodily waste is taboo and performed in private, and our clothing and grooming typically help us avoid the smell and look of wild creatures. Our dining manners and rituals keep us from "eating like an animal," a charge that is clearly an insult.

DARRYL DYCK *AP Photo*

FLESH: Research suggests that people who have been primed to think about death are more likely to be uncomfortable at the sight of a mother breast-feeding in public.

TMT proposes that experiences that remind us of our animal nature will arouse awareness of our mortality, thus causing us to avoid them, especially if mortality salience is already heightened. How we might feel about seeing a woman breast-feeding her infant, for instance, seems to be influenced by whether we have been made aware of our mortality beforehand.

In 2007 Cathy Cox, now at Texas Christian University, and her colleagues published their research on this question. In their first study, college students rated their reaction to a written scenario in which a woman breast-feeds in a fancy restaurant, provoking a negative

As a well-spent day brings happy sleep, so a life well used brings happy death. —Leonardo da Vinci

Death is when the monsters get you. —*Stephen King*

reaction from the restaurant staff. Volunteers who had been primed with the death essay rated the woman 40 percent more harshly than did the students primed by the dental pain essay.

Cox and her colleagues followed up by bringing breast-feeding into the lab, although no actual breast-feeding occurred. The researchers told college student participants that the study involved formation of impressions of another person before completing a task with that person. The subjects were advised that the other participant was a young woman who could not find child care and had to bring her infant along with her; she had arrived early and was feeding the child in the other room.

The students were randomly told either that the mother was breast-feeding or bottle-feeding and then were randomly assigned either to the standard death essay or to the dental pain essay. After filling out a questionnaire about hobbies and interests, the students were presented with what they believed was a like questionnaire that had been completed by the young mother in the other room. In reality, there was no such person, and all students were shown the same fictitious profile. They were then asked to rate their impressions of this other student with whom they would soon be working.

When rating the likability of this mystery woman, students who had written about dental pain returned similar ratings whether the woman was described as bottle-feeding or breast-feeding. Yet those primed with the death essay rated the young mother as less likable when she was said to be breast-feeding. Last, the participants were told it was time to perform the joint task with the young mother. They were taken to an empty room containing only two folding chairs leaning against the wall and were asked to set up the chairs, facing each other, in preparation for the task. The researchers were looking to see how closely the students placed the chairs. The distances between the two chairs were very similar in all but one condition: the students placed the chairs about 20 percent farther apart when they had been primed with the death essay and told that their partner had been breast-feeding.

It appears that when primed to think about our own mortality, we tend to disparage and distance ourselves from reminders that we humans are animals. Other researchers have demonstrated this phenomenon with people's reactions to the elderly, disabled individuals and sexual activity. In an article published in 2000 the originators of TMT (Greenberg, Pyszczynski and Solomon) described research they conducted with their colleague Jamie Goldenberg, now at the University of South Florida. College students who underwent the standard method for inducing mortality salience rated the physical aspects of sex as less appealing compared with students who had not been so primed. The same researchers later found that students primed to focus on the romantic meaning of sex experienced fewer thoughts about death than did those primed to focus on the physical aspects of sex.

HORROR: Enjoying a violent movie or book can let us confront death vicariously while remaining safely insulated from our own mortality.

JAY P. MORGAN *Getty Images*

Handling Death

So what does all this tell us about how we might manage our fear of mortality? If brushes with death help people worry less about it and devote more energy to the things tht give deeper meaning to life, then focused thinking about death might help the rest of us.

We already expose ourselves to death without knowing why. We watch slasher films, read violent novels and news accounts of tragic deaths, and share sick jokes about death and corpses. Such diversions might appeal to us because vicarious experiences of death can satisfy curiosity and address our anxiety in a way that keeps our own mortality at a safe remove. In fact, by choosing exposure to death we exert a degree of control. Death becomes something that prompts a laugh, a groan or a thrill rather than terror. Culturally constructed scenarios of death may serve as a safety valve for venting anxiety.

Repeated exposure to death and dying in naturalistic settings also appears to lower discomfort around the topic. In

BEAU LARK *Corbis*

ENDGAME: Elderly people whose life goals were idealistic, such as the pursuit of meaningful work and relationships, tend to be less anxious about death than those who focused on material accomplishments.

2008 Susan Bluck and her colleagues at the University of Florida published a study of hospice volunteers. Scores on a measure of death anxiety were lower for more experienced volunteers than for novices. Also, the best predictor of the level of their anxiety about death was not the length of time the volunteers had served but the number of deaths they had attended. Ironically, by prolonging human lives and removing our loved ones from their natural habitats when they are dying, medical technology has insulated us from experiences with death; greater anxiety about mortality may be a side effect.

One brief period of thinking about our mortality would probably do little good. Yet repeated contemplation of our eventual death could both lessen the anxiety about it and help keep us focused on the aspects of life that matter most.

Without such focused contemplation, thinking about the end of life is as likely to take us to the darkness as to the light. In a survey of nearly 1,000 students who took her Sociology of Death and Dying course at the University of Louisiana at Lafayette from 1985 to 2004, Sarah Brabant asked her students how often they thought about death. The most common responses were "occasionally" (58 percent) and "frequently" (20 percent). She also asked how the students felt when they thought of their own mortality. The two most common responses were "fearful" and "pleasure in being alive," each at 29 percent.

Within these few statistics lies the human condition. We cannot escape awareness of our mortality, and that awareness has the power to elicit fear or appreciation. Fortunately, the choice is ours. M

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I can't die yet. I'm booked! —George Burns

When **Nice Guys** Finish First

Pleasant people enjoy many advantages in life and, with some effort, can even make it to the top **By Daisy Grewal**

FAST FACTS

Nice Work

1» **People who are nice are those who score high on the agreeableness personality trait. They are generous, considerate of others and pleasant. Such people benefit from good personal and work relationships. They are more likely to get a job—and to keep it.**

2» **Being exceedingly agreeable does have drawbacks, however. Nice people tend to earn less than their more demanding colleagues and to get passed over for promotions.**

3» **Nice people should pay attention to their posture when they find themselves in leadership positions or in situations in which they need to exert authority over other people.**

When I was growing up, my mother used to say, "It's nice to be important, but it's more important to be nice." Yet popular wisdom also tells us that "nice guys finish last" and that "nice girls don't get the corner office." Like most sayings, these last two contain a grain of truth, but they overstate the challenges and overlook the considerable benefits of being nice.

Psychologists define nice people as those scoring high on a personality trait called agreeableness. This trait often goes along with generosity, consideration for others, a pleasant disposition and a strong desire for social harmony. If you are nice, your overriding concern is to maintain positive relationships with others. You feel happiest when those around you are in harmony, and you go out of your way to smooth ruffled feathers. One way of measuring niceness is to ask people how much they agree with statements such as "I take time out for others" and "I sympathize with others' feelings."

Like most personality traits, agreeableness has both rewards and drawbacks. Findings from the field of personality psychology suggest that nice people tend to have stronger relationships, better health, and superior performance at school and on the job. Despite excelling in the workplace, however, exceedingly agreeable individuals typically earn less than their more demanding colleagues and tend to get passed over for leadership positions. Even so, pleasant people can overcome their apparent weaknesses to climb the professional ladder if they choose to do so.

The Spoils of Kindness

A number of studies suggest that being nice has both professional and personal benefits. For one, it may help you

GAIL SHUMWAY *Getty Images (smiley face)*; MARTIN BARRAUD *Getty Images (man)*

Nice people are often passed up for leadership positions. Yet certain postures, such as leaning forward on a table with your arms at your sides, can make an agreeable person feel and seem more powerful.

TONY METAXAS *Getty Images*

land a job. In a 2011 study management professor Michael Tews of Pennsylvania State University and his colleagues investigated how managers weigh ability and personality when making hiring decisions. Tews's team created fake job applicants varying in intelligence and personality. The researchers asked managers which candidates they would most likely make an offer to. The managers greatly preferred the applicants who scored high on agreeableness. In fact, they chose these applicants over people who were smarter but less agreeable.

Being nice may also help you keep your job. In a study published in 2011 organizational psychologist Timothy Judge of the University of Notre Dame and his colleagues found that agreeable people were less likely than unpleasant ones to have ever been fired. One reason may be that managers see nice employees as better at their work. In a 2002 study psychologist Lawrence A. Witt, now at the University of Houston, and his colleagues investigated the impact of personality on performance reviews across diverse occupations. Not surprisingly, they found that conscientious employees received better reviews—but only if these individuals were also agreeable. Employees who were hardworking and reliable but not very nice received lower ratings than the industrious, nice folks did.

Niceness has personal benefits as well. Studies show that agreeable people enjoy longer and more intimate marriages, better relationships with their kids and greater overall satisfaction with their lives. They may be healthier, too. In 2010 researchers at the National Institute on Aging reported that people scoring low on agreeableness were more likely to show thickening of their carotid arteries—a major risk factor for a heart attack. In addition, Judge's team documented that people who score high on agreeableness report experiencing less stress, something that could benefit both relationships and health.

Not Tough Enough?

Despite these advantages, nice people may lose out in other ways. For instance, their excellent job performance does not always translate into higher earnings. In their study Judge and his colleagues found that people scoring high in agreeableness tend to have lower salaries than those who are less likable. Rudeness is unlikely to increase your pay, the authors say. Instead nice people may value relationships more than money, making them hesitant to ask for a raise and risk discord. Or perhaps they are more satisfied with what they are already earning.

Nice people may also earn less on average because fewer of them make it to the top. Powerful people are not usually known for their kindness, and research suggests that achieving a position of power is associated with lowered concern for other people's thoughts and feelings. One reason for this link may be a perception that leadership and kindness are incompatible. In a study published this year organizational behavior professor Nir Halevy of Stanford University and his colleagues gave individuals 10 chips that they could either keep (and receive $2), donate to their entire group (for a profit of $1 for every group member), or contribute to a collective pool that included both members of their group and those of another group (giving everyone a 50-cent profit). In this game, individuals end up richest when everyone is generous and poorest if they donate but no one else does. Afterward, when asked what they thought about their fellow players, participants said they had more respect and admiration for people who gave away their chips. Yet those who added to the collective pool were rated as less dominant than the others.

In another round of the game, people were asked to pick a leader. They ranked individuals who had given money to the collective as less desirable candidates than those who had donated their funds to their own group only. Despite being re-

(The Author)

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Managers greatly preferred the job applicants who scored high on agreeableness—niceness, that is. In fact, they chose these applicants over those who were smarter but not as nice.

spected, these highly generous people were perceived as having less leadership potential.

The stereotype of nice people as weak is misguided, however. Nice people are not necessarily less assertive or competitive than more difficult people are. In one study published in 1997 psychologist William G. Graziano, now at Purdue University, and his colleagues gave groups of three college students 15 seconds to build block towers. In one game, the group with the tallest tower won. In another, the winner was the individual who had placed the most blocks in the tower. After playing the games, the students rated one another's behavior. When the game required cooperation, people who had scored high on a test of agreeableness were judged as being much more generous and helpful than others were. Yet when everybody had to play for himself or herself, the nice folks were seen as just as competitive as others.

Agreeable individuals are not especially likely to let people walk all over them, either. No evidence supports the notion that nice people lack the self-esteem required to stand up for themselves or avoid being taken advantage of. Still, because our culture greatly values assertiveness, nice people may need to work harder to convince others that they have what it takes to be an effective leader.

Power Shifts

Aside from needing to stand up for themselves verbally, nice people can boost their chances of a raise or promotion by paying attention to their body language. The postures we assume in certain situations can influence both how others see us and how we see ourselves. In 2010 psychologist Dana Carney of the University of California, Berkeley, and her colleagues told subjects to spend several minutes in a position that conveys power: lounging backward while putting one's feet up on a desk or leaning forward on a desk with one's arms spread out widely on either side of the body.

Assuming these postures not only made the participants feel much more powerful but also boosted levels of testosterone in both male and female participants. Testosterone is a hormone linked with greater risk taking and competitive behavior. So when you want others to listen to you, it may help to throw your weight around by standing tall, taking up a lot of space and using expansive gestures. Nice people should especially pay attention to their posture when they find themselves in leadership positions or situations in which they need to exert authority over others.

If, instead, you wish you were a little nicer, one option is to practice a form of meditation appropriately dubbed "loving-kindness." In this type of meditation, participants silently repeat wishes for the health and happiness of themselves and others—and in the process they cultivate feelings of empathy, which underpin an agreeable nature. In a study published in 2008 researchers at the University of Wisconsin–Madison and their colleagues scanned the brains of novice and expert meditators. When they heard sounds of somebody in distress played through a speaker while practicing loving-kindness, all the participants displayed heightened activity in the insula, a brain area involved in self-awareness and emotional experience. The expert meditators showed the strongest reactions to the sounds, suggesting that compassion and empathy can be learned. In another study from 2008 psychologists at Stanford University found that people who practiced loving-kindness meditation reported feeling closer and more socially connected to strangers they viewed in pictures.

The benefits of being agreeable depend on how you define success. If success is obtaining the things in life most likely to lead to long-term happiness—good health, strong relationships and enjoyment of what you do every day—nice people have a distinct advantage. My mother might have been right after all. M

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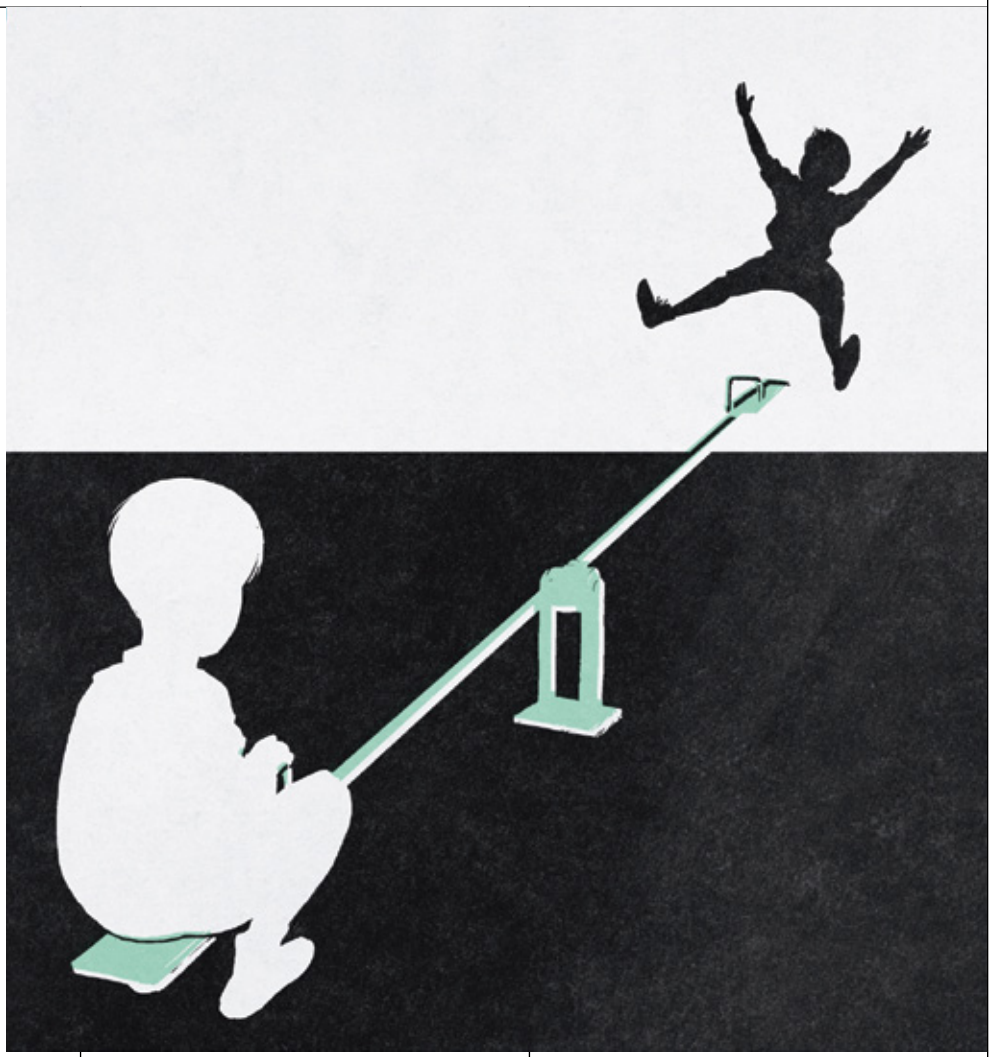
Do Kids Get Bipolar Disorder?

Psychiatrists may be pinning this label on too many children, but the problem has not gone away

BY HAL ARKOWITZ AND SCOTT O. LILIENFELD



IMAGINE an eight-year-old boy whom we will call Eric. He is irritable and talks incessantly. Unable to sit still and concentrate, he does poorly at school. Nevertheless, he claims to be one of the smartest kids in the world and blames his poor academic performance on his "horrible" teachers. There are periods when his mood changes abruptly from euphoria to depression and then swings back again. Eric's symptoms qualify him for a diagnosis of bipolar disorder, which is characterized by episodes of full-blown mania or a less severe form called hypomania. These moods usually alternate with periods of depression [*see box on opposite page*].

Until about 1980 most mental health professionals believed that bipolar disorder did not occur in children. Although a few still hold this view, the general opinion of the psychiatric community has drastically shifted over the past 30 years, a period in which diagnoses of the disorder in kids have skyrocketed. In a study published in 2007 psychiatrist Carmen Moreno, then at Gregorio Marañón University General Hospital in Madrid, and her colleagues found a 40-fold increase between 1994 and 2003 in the number of visits to a psychiatrist in which a patient younger than 19 was given this diagnosis. By 2003, the researchers reported, the number of office visits resulting in a bipolar diagnosis in these youths had risen from 25 per 100,000 people to 1,003 per 100,000 people, a rate almost as high as that for adults.

Such data have sparked widespread concern that the condition is egregiously overdiagnosed, perhaps contributing to the use of ineffective and even harmful medical treatments. In this column, we discuss controversies regarding the overdiagnosis of bipolar disorder in children and recent attempts to remedy this situation.

Tale of Two Manias

In 1980 the American Psychiatric Association came out with a radically revised third edition of its diagnostic bible, the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-III*). This edition debuted the term "bipolar disorder" as a replacement for the earlier term "manic-depressive disorder." The diagnosis required a full-blown manic episode lasting at least a week,

COURTESY OF HAL ARKOWITZ (*Arkowitz*); COURTESY OF SCOTT O. LILIENFELD (*Lilienfeld*); DANIEL STOLLE (*seesaw*)

usually alternating with periods of major depression that extended for at least two weeks. The symptoms had to be severe enough to interfere with social or occupational functioning; for children, the latter refers to how well they perform in school.

In the view of many professionals, some children did—and still do—fit these criteria. In 1994, however, with the publication of the *DSM-IV,* a new category of bipolar disorder appeared. In this volume, the one in use today, the illness is subdivided into bipolar I, essentially equivalent to the *DSM-III* version of this malady, and bipolar II, which has less stringent diagnostic criteria. A patient can be diagnosed with bipolar II if he or she has hypomania, the less severe form of mania, in which the manic episodes can be shorter—four days instead of a week—and do not impair functioning. The inclusion of this milder form of the disorder enabled many more children (as well as adults) to qualify for a bipolar diagnosis.

It is no coincidence then that the dramatic rise in cases of childhood bipolar disorder began as soon as the revised edition of the *DSM* landed on psychiatrists' desks. Many critics have raised concerns that this manual's loosened criteria have misclassified many children as bipolar II who had features too mild to really qualify them for any type of bipolar disorder—or who suffer from entirely different ailments.

Bad Diagnosis, Bad Treatment

Indeed, bipolar II overlaps substantially with other common childhood conditions. For example, attention-deficit hyperactivity disorder (ADHD) and bipolar are both characterized by distractibility, fidgeting, restlessness, high activity levels and excessive talking. Bipolar disorder also shares similarities with conduct disorder and oppositional defiant disorder, which are associated with repeated disruptive behaviors. Such overlaps can lead to misdiagnosis.

The consequences of misdiagnosis are not trivial. Stimulant drugs such as Ritalin and Adderall, which are commonly used to treat ADHD, are not only ineffective for bipolar disorder but may worsen its symptoms or even trigger manic episodes. Meanwhile these drugs may produce side effects such as weight loss, insomnia and nervousness. On the other hand, a child with ADHD who is mistakenly diagnosed with bipolar disorder will usually be prescribed one or more of several medications, including lithium, anticonvulsants such as Depakote or Lamictal, or atypical antipsychotics (Abilify, Zyprexa). All these drugs are ineffective for ADHD and can cause side effects such as weight gain and involuntary movements. Rare but more serious problems such as seizures (from lithium) can show up when the dosage is too high.

Mood Shift

To reduce the problems of overlap and overdiagnosis, the authors of the *DSM-5,* to be published in 2013, have proposed adding a category called disruptive mood dysregulation disorder [see "Redefining Mental Illness," by Ferris Jabr; Scientific American Mind, May/June 2012]. Symptoms of this illness would include frequent temper outbursts and chronically irritable, angry or sad moods. This addition could provide a diagnostic home for many children who would be excluded from a bipolar diagnosis but who did display some of its symptoms. With more accurate diagnosis, doctors hope, children in the two bipolar categories, as well as the new one, will receive more appropriate and therefore better treatment.

Despite the proliferation of categories, some children (those with symptoms like Eric's, for example) can be rightly diagnosed with bipolar disorder using stringent criteria. And no matter how they are labeled, children who display pathological mood swings experience significant distress and are in dire need of proper care. M

Diagnosing Bipolar Disorder

Whether you are a child or an adult, you may qualify for a diagnosis of bipolar disorder if you display symptoms of mania, a state characterized by an elevated, expansive or irritable mood, usually alternating with periods of major depression. In addition to that mood change, a manic episode includes three or more of the following seven characteristics. (At least four of these symptoms must be present if your manic mood is primarily irritable.)

- **Inflated self-esteem or grandiosity.**
- **Decreased need for sleep.**
- **Increased talkativeness.**
- **Racing thoughts.**
- **Distractibility.**
- **Agitation or increase in goal-directed activities such as planning to open a new business.**
- **Engaging in pleasurable activities with high potential for negative consequences.**

—H.A. and S.O.L.

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Send suggestions for column topics to editors@SciAmMind.com

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Old and on the Road

How we can train elderly drivers to be safer

BY WRAY HERBERT

MR. MAGOO, a cartoon regular of early television, was notorious for his hazardous driving. He was a retiree, befuddled and extremely nearsighted, yet he continued to drive despite these obvious failings. In the opening sequence to his long-running show, he had run-ins with a railroad train, a haystack and several barn animals, a roller coaster, a fire hydrant, a mud hole and a high voltage line—all while honking his horn and shouting, "Road hog!"

As we look back, this montage seems like a cruel stereotype of the elderly, especially older drivers. Yet as with all caricatures, the one of Mr. Magoo had a grain of truth in it. The fact is that, mile for mile, senior drivers do have higher crash rates than all other drivers, other than teenagers. Even normal aging is accompanied by declines in vision, cognitive sharpness and physical ability. Isn't it logical that this bad driving would result from these deficits of aging, as the Mr. Magoo stereotype suggests?

Maybe not, says psychological scientist Alexander Pollatsek of the University of Massachusetts Amherst. Pollatsek has been working with colleagues in the university's engineering school to systematically analyze the behavior of older drivers—including their visual scanning of the roads—and his evidence challenges the presumed connection between crashes and these well-known deficits. His work suggests these drivers' mistakes may result from learned habits, which may be correctable.

Look Left, Look Right

Pollatsek and his colleagues have been studying a particular class of accidents in which the elderly, especially those older than 70, are disproportionately involved: right-of-way crashes. These crashes occur when one driver fails to yield properly to another driver at an intersection of some kind. Experts have long assumed that these crashes occur when an elderly driver either cannot see the other car, is distracted and loses concentration or is physically compromised in some way. Pollatsek's group

MATT MENDELSON (*Herbert*); JOSE LUIS PELAEZ Getty Images (*man driving*)

decided to test these assumptions.

The scientists used driving simulators to analyze the visual scanning of both older and middle-aged drivers in realistic driving conditions. Drivers experienced long uneventful stretches of road, punctuated by scenarios involving intersections. For example, a driver might come to a stop sign at a T intersection, which would require yielding to a driver approaching from the left. Or the driver might need to make a left turn across traffic at a four-way intersection with a traffic light. Each scenario contained a visual area that required monitoring for other, perhaps obscured, vehicles approaching with right-of-way. The drivers typically had three seconds to detect and respond to an oncoming vehicle.

Breaking Bad Habits

The scientists measured precisely how long the drivers spent glancing at the potential threat areas as they approached and entered these intersections. Their findings were somewhat unexpected. As reported online February 3 in the journal *Current Directions in Psychological Science,* the older drivers spent significantly less time monitoring these critical visual regions than did the younger drivers. More important, there were no distractions in the simulations—pedestrians, for example—that might cause this poor scanning. Nor were the older drivers less capable of looking around; indeed, they looked around just as much as the younger drivers in general—just not when they should have been attentive to potential threats. In short, a failure to scan for potential hazards was by itself a cause of the crashes—rather than visual, cognitive or physical deficits.

So why are older drivers not watchful in risky situations? Here is where the findings get really interesting. The scientists' measurements suggest that this group of drivers were not mindful because they were spending significantly more time looking straight ahead. In other words, they were not scanning to their left and right, as they should have been, because they were looking elsewhere—in front of their car. The researchers believe that, over time, older drivers become intensely focused on not hitting anything directly in front of the car—to the exclusion of other goals. It is a habit and not a bad one for most routine driving; in intersections, however, the habit is perilous.

Habits can be broken, of course, and the scientists attempted to do just that. They designed an experiment in which older drivers were filmed as they drove near their homes. One camera was mounted on the drivers' head to record approximate line of sight as they looked around, and three other cameras were mounted in the car to monitor driving behavior. After being recorded, the drivers underwent a training session. Some watched the recorded videos of themselves driving through intersections. They also spent time driving in a simulator, where the researchers evaluated them and offered feedback, after which they were allowed to practice proper scanning. Other drivers did not watch the video of themselves and instead got half an hour of instruction, including coaching about the hazards of intersections and how to deal with them. All of them (and a control group that got no instruction) were evaluated in the simulator and on the road afterward.

The results were dramatic. Those who had merely received instruction did no better than the control group in subsequent driving tests. That is, merely being told to be careful had no effect. The older drivers who had received the video feedback, however, were indistinguishable from younger, experienced drivers in negotiating intersections. What is more, these improvements lasted a full year after the training.

The training did not attempt to improve motor skills or attention in the older drivers. The fact that this remediation worked—and so dramatically—means the scanning deficiencies are unlikely to be rooted in basic deficits of aging. The more probable conclusion, according to the scientists, is that the older drivers simply unlearned a bad driving habit.

This conclusion is welcome news. By 2030 one in four American drivers will be 65 or older, and these aging drivers are predicted to be logging more miles on our roads and highways than ever before. Older motorists are holding on to their licenses longer and relying less on others to drive them. Training such as the program used in the study may not help those who are visually, mentally or physically impaired—the Mr. Magoos of the highway—but it could be a simple and inexpensive method for heading off a looming public health problem. M

A failure to **scan for potential hazards** was by itself a cause of crashes—rather than visual, cognitive or physical deficits.

WRAY HERBERT is writer in residence at the Association for Psychological Science.

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

(Further Reading)

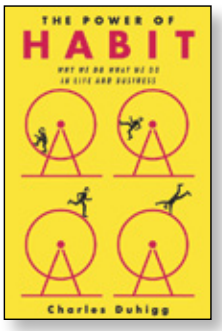
◆ **Identifying and Remediating Failures of Selective Attention in Older Drivers.** Alexander Pollatsek, Matthew R. E. Romoser and Donald L. Fisher in *Current Directions in Psychological Science,* Vol. 21, No. 1, pages 3–7; February 2012.

books

CONTROL YOURSELF

The Power of Habit: Why We Do What We Do in Life and Business

by Charles Duhigg. Random House, 2012 ($28)

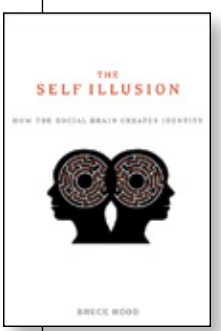


Whether healthy or destructive, habits shape our cognitive wiring. Once they are established, it takes a hefty effort to overwrite those neural connections. In *The Power of Habit,* Duhigg demystifies the brain processes involved in forming and altering these mindless actions.

Mindlessness, in fact, defines a habit, but the routine does not start out that way, writes Duhigg, a *New York Times* reporter. Habits, he explains, are "choices that all of us deliberately make at some point, and then stop thinking about but continue doing." Not only are they a "natural consequence of our neurology," they serve a purpose: without habit, we would spend inordinate amounts of time tending to the mundane but necessary tasks of cleaning, clothing and feeding ourselves. So as we become practiced in a task—essentially, as we learn—mental activity decreases. Studies in rats, for example, show that the brain's basal ganglia "stored habits" while the rest of the brain took a nap.

No surprise, then, that breaking a habit requires cognitive exertion. Habitual actions occur in a loop of cue, routine and reward, with cravings driving the cycle. Luckily, a wealth of science shows you need not deprive yourself of the rewards of your behavior to change it. To break a habit, substitute in a new routine while keeping the original cue and the payoff.

This technique may be familiar to recovering alcoholics or those who have tried to stop smoking or overeating. In a neat twist, however, Duhigg shows how football coaches, military officers, CEOs and even civil-rights pioneers have harnessed this golden rule of habit change to turn losing teams into champions, deflate rowdy crowds, ingrain emotional resilience in employees and alter social norms. Glimpsing how habits come to define us provides a fascinating look into human nature. *—Jordan Lite*



A DIRTY TRICK

The Self Illusion: How the Social Brain Creates Identity

by Bruce Hood. Oxford University Press, 2012 ($29.95)

When a newborn baby's eyes scan a room, Hood writes, the infant does not decide where to focus. Instead inborn cognitive mechanisms respond to the environment and focus the baby's attention. Later in life, the child develops self-awareness and the conviction that he consciously controls his body and brain. Yet what if this belief does not reflect reality?

In *The Self Illusion,* Hood argues precisely that. After exploring various definitions of self—a soul, an agent with free will, some essential and unique set of qualities—he concludes that what we experience as a self is actually a narrative spun by our brain. To see why, consider an experiment in the 1980s by physiologist Benjamin Libet. He showed that neural activity reveals what an individual will do before that person becomes conscious of having made a decision. Perhaps our sense of free will is just a way for our brain to organize our actions and memories, as Harvard University psychologist Dan Wegner has argued. Building on Libet's and Wegner's work, Hood proposes that our sense of self is an after-the-fact organizational trick for the brain. As with a just-so story, our brain synthesizes the complex interactions of biology and environment to create a simplified explanation of who we are.

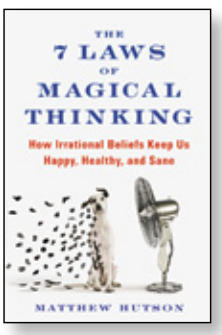
Hood likens this fragile, malleable creation to a spiderweb being tugged in many directions at once. In the infamous Stanford Prison Experiment, for example, college students transformed into brutal guards who abused fellow students playing inmates. A milder illustration comes from the questionnaires used to assess personality traits: respondents alter their answers when imagining themselves in different social contexts. Hood argues that our protean personalities allow us to adapt to new surroundings.

Although Hood believes the self may be the greatest trick our brain has ever played on us, he concludes that believing in it makes life more fulfilling. The illusion is difficult—if not impossible—to dispel. Even if we could, why deny an experience that enables empathy, storytelling and love? *—Daisy Yuhas*

LOGIC OF LUCK

The 7 Laws of Magical Thinking: How Irrational Beliefs Keep Us Happy, Healthy, and Sane

by Matthew Hutson. Hudson Street Press, 2012 ($25.95)



We evolved to be self-aware, to know that we exist. Science journalist Hutson argues that this adaptation came at a price: we cannot imagine our own nonexistence. In his new book, he writes that our self-awareness causes us to search for meaning in life and to cling to the idea that we must be here for a reason. That is where our superstitious musings begin.

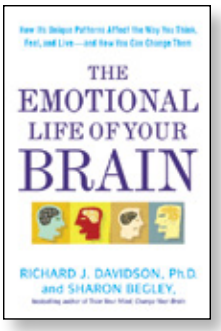
Hutson combines compelling anecdotes with psychological studies to show that mystical thoughts—feelings of awe, luck, superstition or fate—underlie many human behaviors. For example, people often engage in magical thinking after they experience a near miss or eerie coincidence. Surviving a car accident unscathed frames the event in a different, positive light: it could have been worse.

Research supports the notion that we

FINE-TUNING FEELINGS

The Emotional Life of Your Brain: How Its Unique Patterns Affect the Way You Think, Feel, and Live—And How You Can Change Them

by Richard J. Davidson and Sharon Begley. Hudson Street Press, 2012 ($25.95)



Not so long ago scientists downplayed emotions as cognitive flotsam, the product of primitive brain structures that derail logic and reasoning in more evolutionarily sophisticated regions of the cortex. Dramatic advances in brain imaging, however, are challenging that perspective. As psychologist Davidson argues in his new book, *The Emotional Life of Your Brain,* emotions are crucial to how the mind works.

According to Davidson, just as exercise can turn a flabby stomach into a six-pack, mental training such as meditation can fine-tune the brain and, consequently, your emotional style, which he defines as the "consistent way of responding to the experiences of our lives." With science journalist Begley, Davidson maps the six dimensions of emotional style—resilience, outlook, social intuition, self-awareness, sensitivity to context, and attention. The authors also provide user-friendly questionnaires for readers to assess where they fall on those scales.

Davidson made waves in 2004 and 2007 after he recorded brain activity in Buddhist monks who were masters at meditation. He found that meditating caused lasting modifications to their brain's wiring, creating stronger connections among regions important to attention, motivation and empathy and increasing brain activity, all of which help to explain the clarity that practitioners report. Davidson's discovery formed the basis for his theory that even ordinary people can change their emotional style by tweaking their behavior. A study published in 2011 in *Psychiatry Research Neuroimaging* supports this idea by revealing that even novice meditators showed an increase in gray matter, responsible for learning, memory and self-awareness.

Only in the final chapter does Davidson suggest self-improvement techniques, such as ways to develop a more positive outlook, become more self-aware or build resilience. He acknowledges, too, that certain methods, such as "well-being therapy," in which practitioners affirm their self-worth and make a point of expressing gratitude and offering compliments, remain unproved. Still, evidence indicates that some techniques, especially meditation, do restructure the brain regions and neural connections associated with specific emotional styles. Whether they will enhance your life, well, only you can say.

—Jordan Lite

often rationalize surprising or unlikely events with magical thinking. In one experiment, investigators divided two roulette wheels into either three or 18 spaces colored red, blue or yellow and told participants that they would win every time the ball landed on a red space. The subjects had the same one-in-three chance of winning with either wheel but perceived hitting a red to be more difficult on the 18-space game because those spaces appeared to be closer to a yellow or blue. Believing they had defeated steeper odds by winning on the 18-space wheel made the participants feel luckier.

Coincidences can also incline us toward thoughts of fate. Hutson describes a married couple who stumbled on an old photograph from the wife's childhood. Although the two did not know each other as children, they were pictured together simply by chance. Hutson explains that instead of disconnecting us from reality, magical thoughts—such as "luck allowed me to survive the crash" or "fate pulled me toward my soul mate"—actually help us rationalize life's mysteries.

However far-fetched it sounds to a scientific mind, magical thinking might bestow significance on our otherwise seemingly arbitrary lives. *—Brian Mossop*

ISTOCKPHOTO

ROUNDUP

Overcoming Mental Blocks

Three books point the way to a better brain.

Forget a midlife crisis: journalist Mark S. Walton argues that our brain actually gains new powers midway through life. In **Boundless Potential** (McGraw-Hill, 2012), Walton explains the neuroscience behind people's ability to reinvent their careers, finances and love lives at 40, 50, 60 and beyond. He also provides tips for how readers can do the same.

In **What Makes Your Brain Happy and Why You Should Do the Opposite** (Prometheus Books, 2011), science writer David DiSalvo describes how the shortcuts our brain uses to navigate the world can also cloud, bias and distort our judgment. DiSalvo combs through recent research for ways to identify and prevent such mental foibles.

Why do some of us see a half-empty glass, whereas others see it as half full? In **Rainy Brain, Sunny Brain** (Basic Books, 2012), psychologist and neuroscientist Elaine Fox explores the connection between optimism and happiness and describes techniques such as cognitive-behavior therapy that can help us change how we view the world. Retraining our brain can allow us to think more positively and relieve stress. *—Victoria Stern*

askthe**Brains**

Is a bad mood contagious?

—Michael Lenneville, Washington, D.C.

Gary W. Lewandowski, Jr., *associate professor of psychology at Monmouth University and co-editor of www.ScienceOfRelationships.com, provides an answer:*

WHEN YOU SEE someone coughing, you reflexively know to steer clear of his or her germs. When you observe someone who is cranky or complaining, it is less obvious what to do. Studies suggest, however, that others' moods may be as easy to catch as their germs.

Psychologists call this phenomenon emotional contagion, a three-step process through which one person's feelings transfer to another person. The first stage involves nonconscious mimicry, during which individuals subtly copy one another's nonverbal cues, including posture, facial expressions and movements. In effect, seeing my frown makes you more likely to frown. People may then experience a feedback stage—because you frowned, you now feel sad. During the final contagion stage, individuals share their experiences until their emotions and behaviors become synchronized. Thus, when you encounter a co-worker on a bad day, you may unknowingly pick up your colleague's nonverbal behaviors and begin to morph into an unhappy state. Mimicry is not all bad, however; a person can also adopt a friend or colleague's good mood, which can help enhance their bond.

Although mimicry often occurs outside of our awareness, sometimes we can observe it. Let us say you see someone across from you on the train yawn. Often you cannot help but yawn as well. Recent research suggests that this type of mimicry is more common when the person yawning is someone close to you, such as a family member, good friend or romantic partner. Another study revealed that nonconscious mimicry, also dubbed the chameleon effect, occurs more often in more empathetic people.

Nonconscious mimicry occurs more often in more empathetic people.

The contagious nature of emotions can become amplified when individuals are in frequent contact with one another. In one study, marriage researchers Lisa A. Neff of the University of Texas at Austin and Benjamin R. Karney of the University of California, Los Angeles, examined more than 150 couples for three years to determine how one spouse's stress influences the other spouse and overall marital quality. They found that wives were not affected significantly. Husbands, however, experienced lower marital satisfaction when their wives reported higher stress. More important, emotional crossover was more pronounced when the couple engaged in negative conflict-resolution practices, such as rejecting or criticizing the partner.

These studies emphasize the importance of choosing wisely the company you keep, so you can catch others' good moods, rather than their bad moods.

Why does exercise make us feel good?

—David Graybill, Wilton, Conn.

Jeannine Stamatakis, *instructor at several colleges in the San Francisco Bay Area, responds:*

THERE IS NO DENYING the high you feel after a run in the park or a swim at the beach. Exercise not only boosts your physical health—as one can easily see by watching a marathon or a boxing match—but it also improves mental health.

According to a recent study, every little bit helps. People who engaged in even a small amount of exercise reported better mental health than others who did none. Another study, from the American College of Sports Medicine, indicated that six weeks of bicycle riding or weight training eased stress and irritability in women who had received an anxiety disorder diagnosis.

To see how much exercise is required to relieve stress, researchers at the National Institute of Mental Health observed how prior exercise changed the interactions between aggressive and reserved mice. When placed in the same cage, stronger mice tend to bully the meeker ones. In this study, the small mice that did not have access to running wheels and other exercise equipment before cohabitating with the aggressive mice were extremely stressed and nervous, cowering in dark corners or freezing when placed in an unfamiliar territory. Yet meek rodents that had a chance to exercise before encountering their bullies exhibited resistance to stress. They were submissive while living with the aggressive mice but bounced back when they were alone. The researchers concluded that even a small amount of exercise gave the meeker mice emotional resilience.

The scientists looked at the brain cells of these so-called stress-resistant mice and found that the rodents exhibited more activity in their medial prefrontal cortex and their amygdala, both of which are involved in processing emotions. The mice that did not exercise before moving in with the aggressive mice showed less activity in these parts of the brain.

Although this study was done in mice, the results likely have implications for humans as well. Exercising regularly, even taking a walk for 20 minutes several times a week, may help you cope with stress. So dig out those running shoes from the back of your closet and get moving. M

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

JAMIE CARROLL *iStockphoto*

Head Games

Match wits with the Mensa puzzlers

1 MEET YOUR MATCH

Here are five matchsticks. Arrange them so they make two triangles. (You may not bend, break or fold any of the matchsticks or place them on top of one another.)

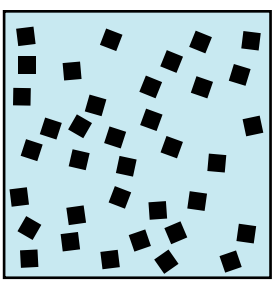
2 SNEAKY SERIES

What comes next in the following list?

M31; A30; M31; J30; J31; A31

3 BEAN COUNTER

Use just four straight lines to divide the container below into eight sections so that the sections contain 1, 2, 3, 4, 5, 6, 7 and 8 of the little squares, respectively.



4 LITERARY MATH

Start with the number of trombones of *The Music Man* fame, add the number of days in *Around the World in ____ Days,* then divide by the number of cities in *A Tale of ____ Cities.* What number do you get?

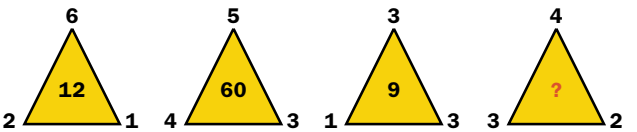
5 MIRROR IMAGES

In the puzzle below, two definitions are given for each blank line. The definition on the left is for the word as it normally appears; the definition on the right is for the word spelled in reverse.

a) skin growths	_____	**dried stalks of grasses**
b) cease	_____	**cooking instruments**
c) breathing	_____	**badness**
d) swaddle	_____	**settled accounts**
e) scolded	_____	**hand over**

6 HIDDEN PATTERN

The number in the middle of each triangle is related to the numbers at the points. The same relation applies to all four triangles. What should the center number be in the last triangle?



7 WORD MORPH

It doesn't have to take 30 days. Go from June to July in eight steps, changing one letter at a time to make a valid English word.

JUNE

____

____

____

____

____

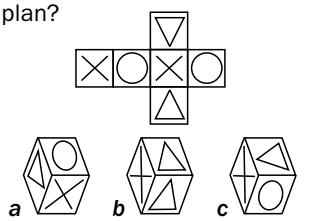
____

____

JULY

8 LAYOUT

Which cube cannot be made from this plan?



9 SCRAMBLE

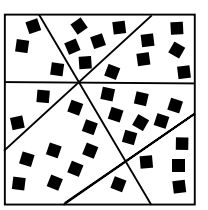
Figure out the missing letter and find the nine-letter word scrambled in the square below.

S	S	I
R	?	A
O	N	D

Answers

1. 

2. S30. (The letters are the months in order starting with March; the numbers are how many days are in that month.)

3. 

4. 78. (76 + 80 = 156; 156/2 = 78.)

5. warts/straw, stop/pots, live/evil, diaper/repaid, reviled/deliver.

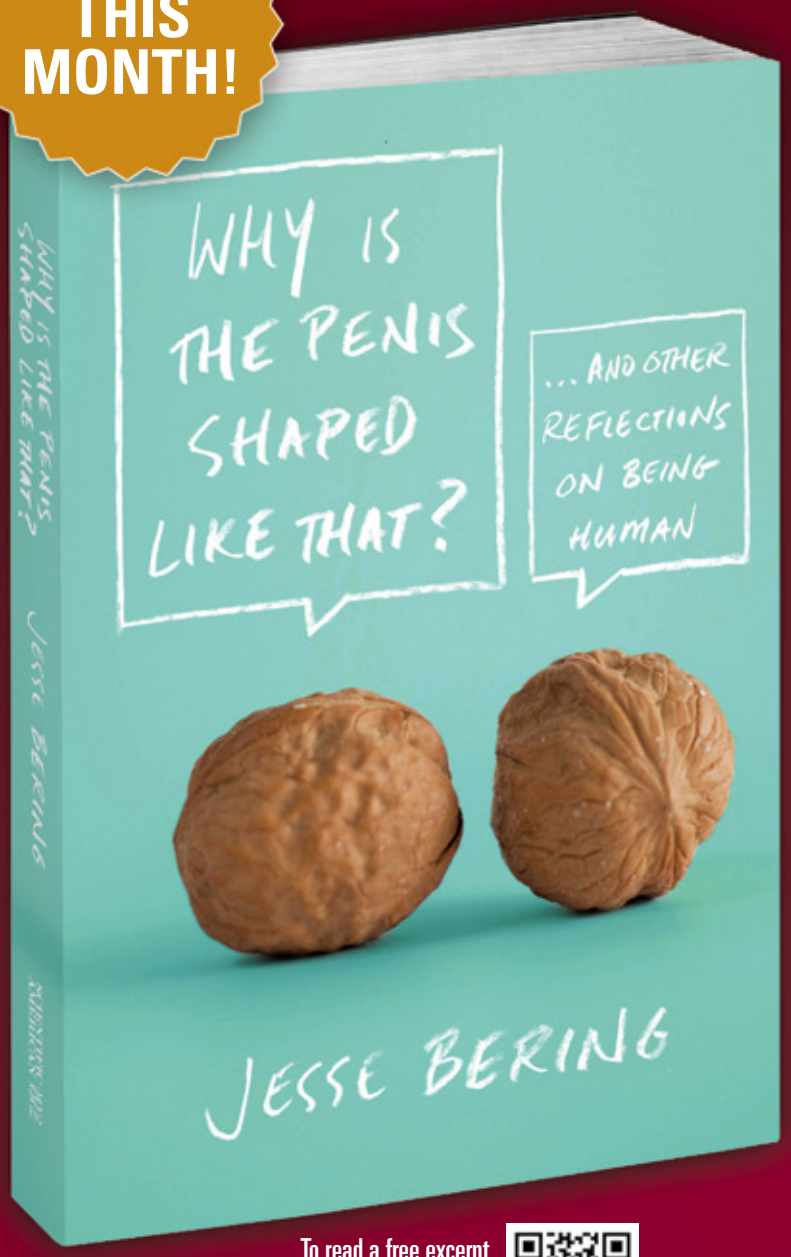
6. 24. The center number is the product of multiplying the numbers at the points.

7. Here's one solution: JUNE, DUNE, DURE, CURE, CURL, BURL, BURY, JURY, JULY.

8. b.

9. Dinosaurs.

NEW THIS MONTH!



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EAST MEDITERRANEAN

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Been there, done that? Think again! Italy, Turkey, Israel, and Greece have drawn explorers over the span of 5,000 years. Bright Horizons is heading in to experience the region through new eyes, new data, and new discoveries as Classical cultures and cutting-edge science converge in the Eastern Mediterranean. Share in the new thinking required by a changing world on Bright Horizons 15 aboard the Costa Mediterranea, roundtrip Genoa, Italy, October 25 – November 5, 2012.

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Sampling of Topics

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- NEUROSCIENCE MEMORY
- COGNITIVE NEUROSCIENCE
- CLIMATOLOGY
- HUMAN EVOLUTION

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ASIA

April 11 – 25, 2013

Get the big picture on astronomy, genomics, and mind- boggling East Asia with Scientific American on Bright Horizons 17. Go deep into cutting edge science while absorbing experiential knowledge of the dynamism and duality of a region on the move. Join us on the Celebrity Millennium April 11–25, 2013 from Hong Kong to Shanghai, visiting ports in China, Taiwan, Japan, and Korea.

Look into the big picture of geospatial imaging with Dr. Murray Felsher. Peer into the past and future of telescopic space exploration with Dr. Stephen Maran. Hear a forecast on genomic technologies, next generation science and medicine with Professor John Mattick. Map the potential research directions whole-genome sequences facilitate with Dr. Mohamed Noor. Update your knowledge of galaxy evolution with Dr. Elaine Sadler.

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Sampling of Topics

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- COSMOLOGY
- PLANETARY SCIENCE
- EVOLUTION
- GEOSPATIAL IMAGING

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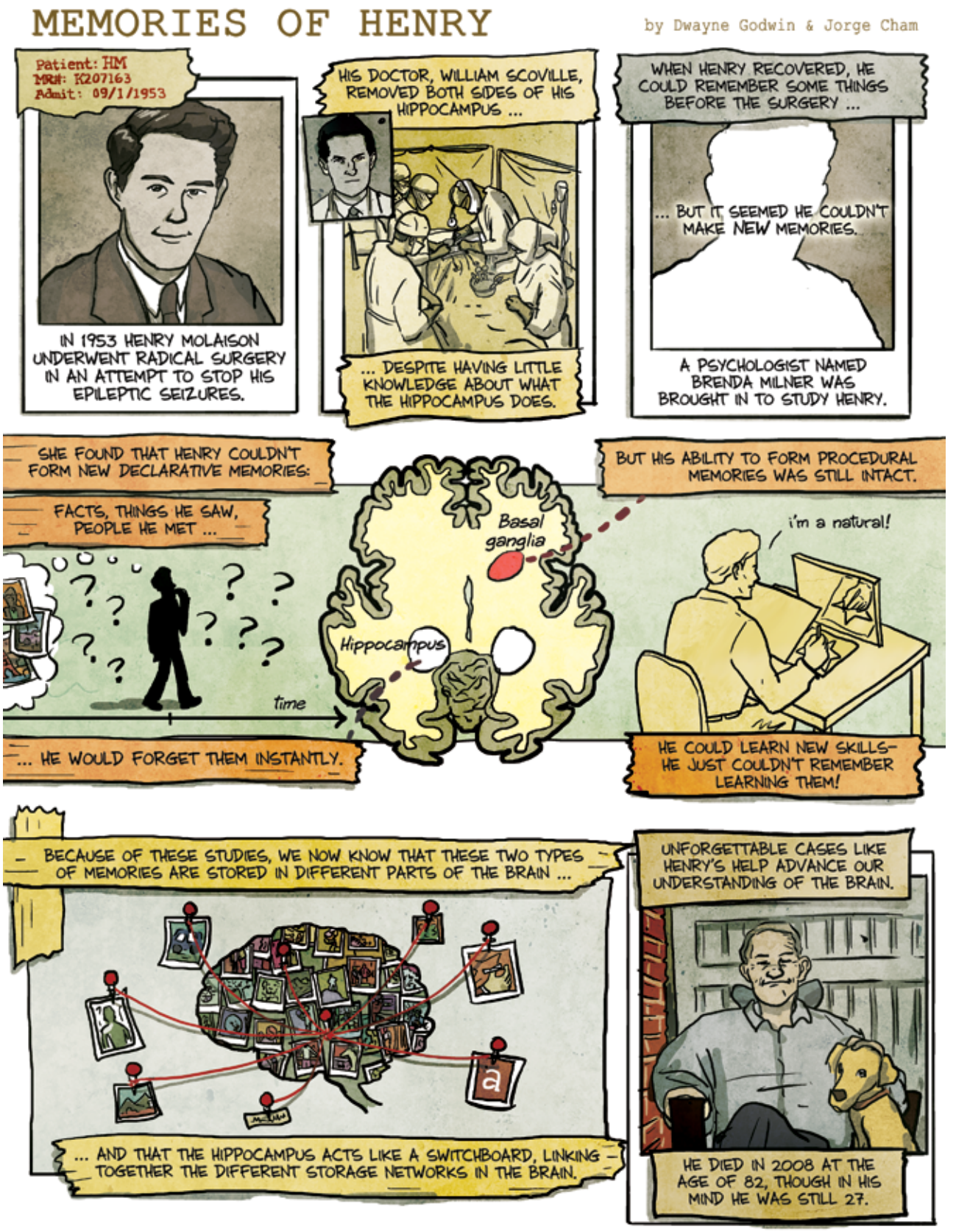
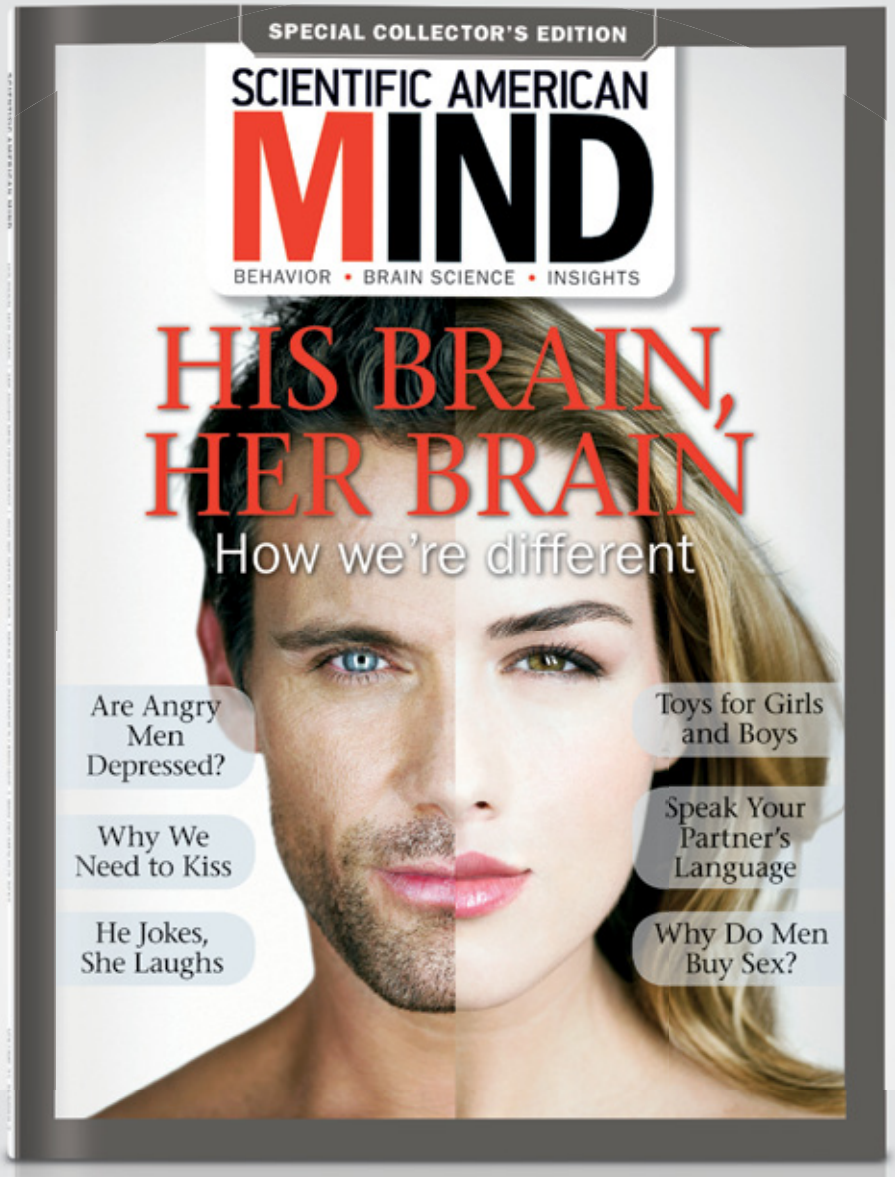


Dwayne Godwin is a neuroscientist at the Wake Forest University School of Medicine. Jorge Cham draws the comic strip Piled Higher and Deeper *at www.phdcomics.com.*



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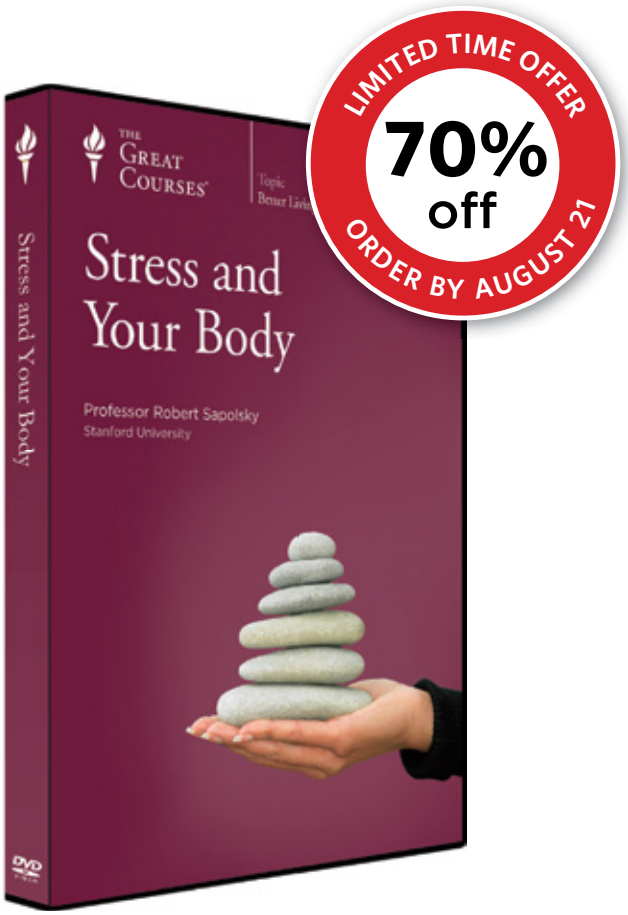

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