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Wisdom of Crowds
Banding Together When It Counts

Beyond Freud
Psychodynamic Therapy

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COVER IMAGE BY AARON GOODMAN

Presto!

The hat with the fake bottom, which conceals a rabbit. The handkerchiefs tucked up one sleeve. And the box that has fake feet sticking out of one end, so the lady can be "sawed" in half (actually, she's curled safely in one side). We think we know some of the common tools in the magician's bag of tricks. But what we haven't noticed—because of their deceptive skill—is that their number-one sleight facilitator is our own, untrustworthy mind.

Over many years conjurers have honed the high art of manipulating our brains. They deliberately divert our attention and focus to fool us with their delightful capers. An innocent-looking adjustment of eyeglasses with one hand can conceal a smooth movement by the other to hide a coin. Magicians' "field research" has only recently become appreciated by neuroscientists working in labs—who use different means but who also study attention and awareness, a facet of the study of consciousness and one of the hottest areas of neuroscience.

Working with performers, neuroscientists are probing the neural correlates of attention. To learn more, turn to page 22 for our cover story, "Mind over Magic?" by neuroscientists Stephen L. Macknik and Susana Martinez-Conde. On www.ScientificAmerican.com/Mind, we also feature a video demonstration with the authors and the "gentleman thief" Apollo Robbins.

What is the trick to raising children well? Psychologist Robert Epstein offers 10 essential skills in "What Makes a Good Parent?" on page 46. Some will surprise you. It may be obvious that every child needs love, but did you know that how you treat your partner—and yourself—matters a lot? Children do not like conflict, and how you handle stress is not just your problem. Parents who cope well tend to have better relationships with their kids. Fortunately, we can all learn ways to help manage life's pressures, such as meditation. You might even consider taking in a magic show.

Mariette DiChristina
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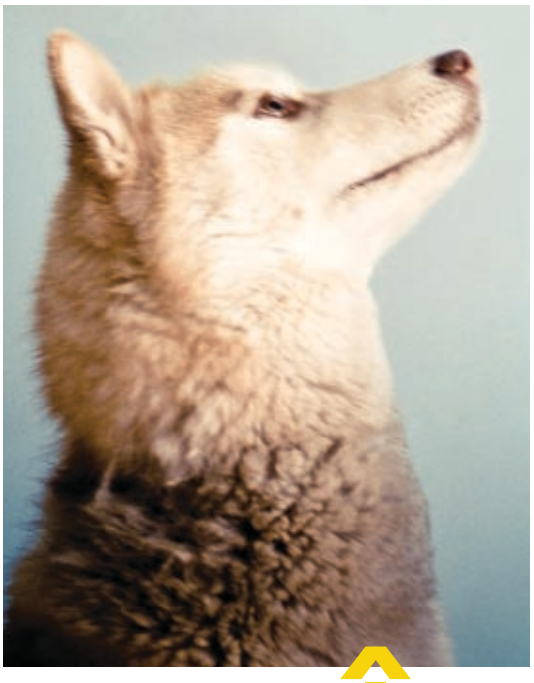
FEATURES

DEPARTMENTS



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WHERE IS MEMORY, EXACTLY?

In your July/August issue the location of human memory comes up in at least three places.

In Ask the Brains, on page 70, David Smith mentions "the hippocampus, which encodes and stores memories."

In "The Mechanics of Mind Reading," on page 56, Daniel Bor writes about "patterns in the part of the brain that stores memories, the hippocampus."

But then, on page 24, Anthony J. Greene, in "Making Connections," says that "learning and memory are not sequestered in their own storage banks but are distributed across the entire cerebral cortex." Do these researchers talk to one another?

Jerry Darnell
via e-mail

THE EDITORS REPLY: *Darnell is not the only reader who wrote to us about this apparent contradiction. All three researchers are correct: the hippocampus indeed stores memories in the sense that it processes experiences and encodes them as memories elsewhere in the brain. The hippocampus is the librarian, not the library. As Greene explains in detail, the brain does not have a memory storehouse: memories are not filed in any particular location but rather as a complex web of connections throughout the entire brain.*

MORE THAN DRAMA QUEENS

I want to thank you for your excellent article on borderline personality disorder (BPD). As a psychiatrist, I felt the article provided an excellent overview of BPD. I wrote to you several months ago after reading an earlier article on BPD ["Dangerous Liaisons," by Ophelia Austin-Small, November/December 2009], indicating that I felt that article was flawed, judgmental and not up to the scientific standards that I have come to expect from your magazine. This article has restored my confidence in your journalistic practices.

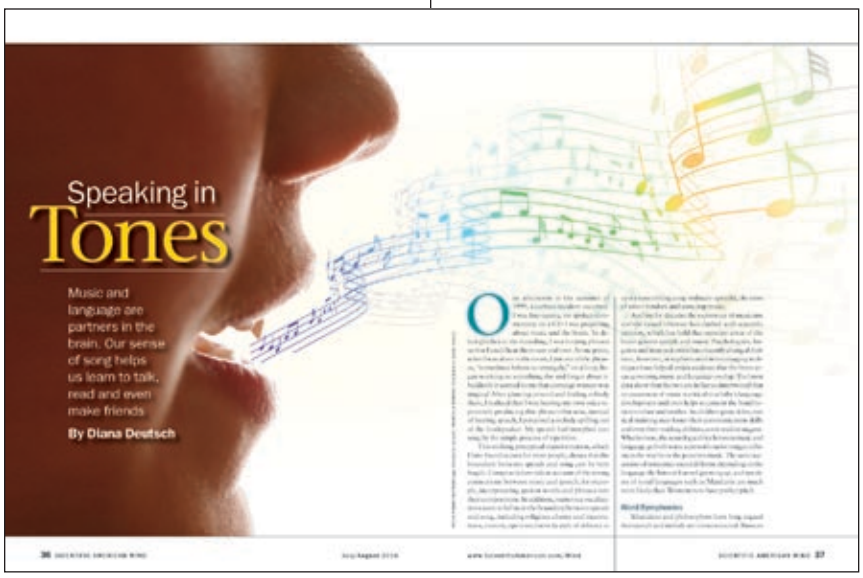
Deanna Mercer
University of Ottawa
Ontario

I have loved your magazine for years, reading it cover to cover, sometimes twice. *Scientific American Mind,* always on the cutting edge, is exactly where I expect to find an article on borderline personality disorder that is filled with facts and is lay-friendly to read. Bravo to Amanda Wang for sharing her story. Having struggled with BPD for years, I, too, have felt crazy and very lonely. With my widely swinging emotions and anger, I have received endless criticism and blame for not acting "normal." The stigma of mental illness is hard to conquer, and the BPD diagnosis makes it harder. Thank you for bringing much needed knowledge to the public and speaking about the treatments that exist. Most important, thank you for filling the article with hope for everyone struggling with this journey.

Anonymous
Connecticut

SOUND AND SPEECH

I read with interest the excellent article by Diana Deutsch, "Speaking in Tones." Many years ago I discovered that I had a habit I might call "extreme onomatopoeia," which involves "matching" environmental sounds in my head to a word or phrase with a similar inflection and rhythm. When I drop a pen on my desk with a rattle, I might hear the phrase "who did that" or "break away." A creaking door might trigger the word "legal"



Every sound we hear, including the tones of speech, activates brain areas that decode melody, rhythm and other features we associate with music.

or "beneath it all." As you can see, the connection is not semantic but simply one of tone. This processing would seem to occur in the overlap area Deutsch has identified, between linear semantic speech and lyrical sonorous music.

On a related note, I wonder to what extent our cultural biases and political or interpersonal clashes might arise from misperceptions orchestrated (so to speak) by differing linguistic tones.

Nora Miller
Tucson

SEEING SEX EVERYWHERE

After suffering through the special issue on "Male vs. Female Brains" [May/June 2010], I expected my reading would be free of sex-and-relationship cant for a while. The new issue dashed my hopes.

Too many recent cover photos have been related to sex or relationships: the attractive woman wearing a skimpy T-shirt and looking mysterious, the half-man/half-woman composite, the woman and man gazing into each other's eyes. Usually a picture of an unclad woman is snuck in somewhere (she's curled up inside Mrs. K.'s head on page 58 in the July/August issue). And so many article titles have to do with sex: "Sex in Bits and Bytes," "How Science Can Help You Fall in Love," and on and on.

Sure, sex may sell more magazines, at least to a certain demographic and at least in the short term. But some folks, including me, subscribed for other reasons. If I want titillation, I'll buy some other magazine that focuses directly on it (and with which SciAm Mind cannot compete). When I pick up Mind, I expect more well-rounded coverage that is not preoccupied with one particular topic.

Chuck Kollars
Ipswich, Mass.

A QUESTION OF NERVES

Regarding "Closing the Gap," by Valerie Ross [Head Lines], I think there is a flaw in the beanbag experiment the researchers used to confirm that desired objects appear closer. True, people tossing at a $25 gift card fell shorter than those tossing at a card worth nothing. But any golfer will tell you that when people putt with money on the line, they will more often putt short of the hole. The difference is not perception but rather performance when risk is involved—the muscles tense up. In addition, when people notice that they have more adrenaline pumping through their bodies, they will often overcompensate in their attempt to relax. I buy the evidence in the other experiment (in which thirsty participants judged a water bottle as being closer than it actually was), but I think other factors affect the beanbag test.

Chuck Gray
Atlanta

PEOPLE WITH AUTISM

In Erica Westly's article "Too Much, Too Young" [Head Lines], she uses the phrase "autistic toddlers." I feel it is important that the editors recognize the disrespect inherent in that construction. The reverent phrasing would have been "toddlers with autism," because people with autism (or any disability) are people first! This sentiment is exactly why we have the Americans with Disabilities Act and not the Disabled Americans Act. I would recommend, or at least request, editing articles of this ilk with an eye out for similar lapses in judgment.

Greg O'Brien
Gray, Maine

HAPPY SPENDERS

In "Born into Debt" [Head Lines], Valerie Ross reports that people carrying two "low" versions of a gene are 15.9 percent more likely to go into credit-card debt than those who have two "high" versions. As Ross explains, the gene in question affects levels of monoamine oxidase A (MAOA), a chemical that breaks down neurotransmitters in the brain. It occurred to me that some very powerful antidepressants are monoamine oxidase inhibitors—they prevent MAOA from doing its job. It follows that people carrying two "low" versions of the MAOA gene produce less MAOA and are, in effect, genetically antidepressed. I can believe such people would enjoy shopping, restaurants and having fun—and perhaps be too impulsive to care about credit-card bills piling up. In contrast, depressed people usually are deeper thinkers who are less receptive to the modern marketing stimuli.

So perhaps "Born into Debt" should be "Born to Be Happy?"

Filomena Fabbrocile
Dublin, Ireland

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MARIO WAGNER

>> CREATIVITY

The Mad Artist's Brain

More evidence for the long-suspected physiological link between inventiveness and mental illness

The popular perception of creative thinkers and artists is that they often also have mental disorders—the likes of Vincent van Gogh or Sylvia Plath suggest that creativity and madness go hand in hand. Past research has tentatively confirmed a correlation; scientific surveys have found that highly creative people are more likely to have mental illness in their family, indicating a genetic link. Now a study from Sweden is the first to suggest a biological mechanism: highly creative healthy people and people with schizophrenia have certain brain chemistry features in common.

A research team at the Karolinska Institute in Stockholm studied 13 mentally healthy, highly creative men and women. As noted in the paper published in May in *PLoS ONE,* other scientists had previously found that divergent thinking, or the ability to "think outside the box," involves the brain's dopamine communication system. The Swedish research team used PET scanning to determine the abundance of a particular dopamine receptor, or sensor, in the creative individuals' thalamus and striatum, areas that process and sort information before it reaches conscious thought—and that are known to be involved in schizophrenia. The team found that people who had lower levels of dopamine receptor activity in the thalamus also had higher scores on tests of divergent thinking—for instance, finding many solutions to a problem.

Previous work has shown that people with schizophrenia also have lower dopamine receptor activity in the thalamus—and the scientists suggest in their paper that this striking similarity demonstrates a "crucial" link between creativity and psychopathology. "Thinking outside the box might be facilitated by having a somewhat less intact box," writes lead author Fredrik Ullén, a cognitive scientist at Karolinska.

—Elizabeth King Humphrey

>> CHILD DEVELOPMENT

Babies on the Edge

When they learn to walk, toddlers must figure out their limitations all over again

Mountain goats are born understanding where they should and shouldn't climb, but baby humans need practice puttering around before they can make sound judgments. Now New York University developmental psychologist Karen Adolph has found that for each new phase of motor development, infants have to relearn how to keep themselves safe.

Adolph tested how infants judge risk by setting 12- and 18-month-old infants at the top of an adjustable wooden "cliff" and having their mothers beckon them over the edge. (Lab staff guarded the babies closely and caught any who actually tumbled off.)

Babies who had been crawling for months generally did not go over drop-offs that were too big for them, nor did babies who had been walking for a while. But many babies who had just started walking marched straight over drop-offs beyond their capabilities—even the highest, most obvious three-foot plunge.

What that means, Adolph explains, is that crawling infants do not learn to be afraid of heights. Instead they learn what their crawling bodies can do, and when their style of locomotion changes, they need practice to recalibrate how they perceive their abilities.

Adults adjust to changing motor limitations every day: they may shift their body weight to ease up on a sore leg or take smaller, more deliberate steps when there is ice on the ground. Adolph says we learn that adaptability as infants by experimenting with physical limits and making mistakes.

For parents, of course, there's another lesson in the research: unless your kids are mountain goats, keep a watchful eye on them when they start to walk.

—Mara Grunbaum

>> RELATIONSHIPS

Love Is in the Air

Romantic music boosts men's chances with the ladies

The surest way to a woman's heart may be through her ears. In a study published in the July issue of *Psychology of Music,* researchers at the University of Southern Brittany in France exposed single 18- to 20-year-old women to either music with romantic lyrics or neutral lyrics while they waited to complete a taste test with a 20-year-old male research assistant posing as another student volunteer. During a break, the male confederate asked the female participants for their phone number. Fifty-two percent of the women who heard romantic music said yes compared with only 28 percent who heard neutral music—something to think about next time you're playing the jukebox.

—Ferris Jabr

>> FAIRNESS

That's Nice, Now Get Out

Generosity is sometimes unwelcome

It's no surprise that humans dislike greediness. But a study in the August issue of the *Journal of Personality and Social Psychology* found that people sometimes punish generosity, too. The subjects played a computer game where opponents put points (worth money) into a common pot. Afterward, subjects often voted to kick out of the group computer-controlled players who put in more points and took less than the others. Perhaps people recoiled because the overgivers violated social norms—rules are rules, even if breaking them benefits everyone—or because they set high standards that players are reluctant to measure up to. Because of our natural aversion to inequality, the study authors say, we sometimes find generosity as annoying as selfishness.

—Valerie Ross

CORBIS (*top left*); GETTY IMAGES (*top right*); MUHARREM ÖNER *iStockphoto* (*bottom*)

>> MOOD

Any Excuse for Busyness

People who find reasons to occupy their time with activity may be happier

Although most of us recoil at the idea of "busywork," such mindless tasks can boost our mood—as long as we have an excuse to perform them, according to a study in the July issue of *Psychological Science*. Psychologists at the University of Chicago and Shanghai Jiaotong University offered subjects a choice between rebuilding a beaded bracelet or sitting idly during a 15-minute wait. Most chose to sit idly—unless they were given the chance to rearrange the beads instead of to rebuild it as it was. In another experiment, subjects filled out a survey and then had a choice either to turn it in to the assistant in the room and then wait, doing nothing, until the next part of the experiment could begin, or they could kill the time by walking the survey over to another building to turn in. In all cases, the students were offered a candy when they turned in their survey, but only when the candies in each location differed did more students opt to take the walk. The results were the same no matter which type of candy was offered in either location, suggesting that the students were choosing the distant candy simply to rationalize taking the walk.

The results of both experiments suggest that when there is an excuse, such as doing something artistic or getting a different reward, people like to keep busy—and indeed, those who chose the busier option reported feeling happier afterward, on average, than those who did nothing. The researchers suggest that next time you're waiting around for something to happen, think of a reason to keep yourself busy—even simple activities such as taking a walk or organizing a closet could boost your mood. *—Allison Bond*

>> FIRST IMPRESSIONS

Beware Your Beverage

People judge alcohol drinkers as less intelligent

We all know alcohol impairs a person's reasoning abilities. But in a study presented at the annual meeting of the Academy of Management in August, researchers reported that booze also diminishes how smart others perceive us to be. In a series of six experiments, the investigators consistently found that participants rated people in pictures, videos and face-to-face encounters as less intelligent when they held or drank alcoholic beverages than when they drank nonalcoholic beverages or nothing at all. The "imbibing idiot bias," as the researchers call it, persisted even when participants drank fake alcoholic beverages that did not interfere with their cognitive functioning. Most strikingly, in mock interviews volunteers judged job candidates as less intelligent when they ordered an alcoholic drink—even when the person interviewing them had done so first. *—Ferris Jabr*

>> SLEEP

Things That Go Bump in the Night

A merciless experiment reveals why some people can snooze through anything

Some people wake up at the drop of a pin; others snooze through their alarms every morning. Whether you can sleep through noise has a lot to do with the brain waves you produce while you sleep, according to a new study published in *Current Biology*. And good news for insomniacs: it might one day be possible to manipulate these waves to ensure a good night's rest.

Previous research has shown that when people sleep, the thalamus—a brain structure that connects the high-level thought areas with the sights and sounds of the outside world—produces brief, high-frequency brain waves called spindles. Scientists speculated that these spindles shut out environmental sounds during sleep. To find out, Jeffrey Ellenbogen, chief of the division of sleep medicine at Harvard University's Massachusetts General Hospital, and his colleagues asked 12 healthy people to spend three nights in his sleep lab. The first night the researchers measured spindle activity while the subjects slept individually in quiet rooms. The second and third nights the researchers relentlessly bombarded each snoozing participant with recordings of common noises such as toilets flushing, phones ringing and people talking, starting each noise at a low volume and repeating it more and more loudly until the subject was aroused from sleep. Then they repeated the process as soon as the person fell asleep again.

The researchers discovered that "the more spindles one has, the more likely they are able to stay asleep when they are confronted with sounds," Ellenbogen explains. Compared with subjects who produced few spindles on the first night, those who produced many had to be bombarded with louder sounds to wake up. Because spindle production dwindles with age, the findings could explain why older people frequently complain of poor sleep.

In future research, Ellenbogen plans to explore why some people produce more spindles than others. Eventually he hopes to find drugs or devices that will boost natural spindle production and induce better sleep. "The capacity of our brain to block out at least some sound is truly amazing, given that our ears are wide open all night long," he says. *—Melinda Wenner Moyer*

GETTY IMAGES (*top left*); CHRISTOPHER BISSELL *Getty Images (top right)*; AGE FOTOSTOCK (*bottom*)

>> RECOVERY

Soothing Traumatized Children

Coloring books developed by psychologists help kids avoid long-lasting emotional problems

A young earthquake refugee enjoys a generic coloring book in Haiti. The Mercy Corps books offer even more benefit to kids' mental health.

ROGER LEMOYNE *Redux Pictures*

Among the vital supplies sent to Haiti in the aftermath of the earthquake, some of the most important may turn out to be thousands of kids' coloring and activity books. Created by Mercy Corps, an international relief organization based in Portland, Ore., these workbooks are designed to help traumatized kids process what happened to them. Building on recent psychological research, the workbooks aim to provide children who do not have access to professional counselors the tools to heal on their own.

Recent research has revealed abnormal patterns of brain activation in people who have experienced psychological trauma. The hemispheres of the brain normally operate in concert, but there are subtle differences in their tasks. The right side tends to be responsible for more emotional, nonverbal processing, whereas the left hemisphere is more logical, linear and verbal. Many people suffering from post-traumatic stress disorder (PTSD) and other stress-related disorders show increased activity in the right hemisphere of the brain—and in emotional, nonverbal processing—and decreased activity in the left, according to neuroimaging studies.

The goal in treating trauma is often to get the linear left hemisphere back into action, says Carol Dell'Oliver, a psychologist and trauma specialist in Portland who helped to develop the workbooks. The books sent to Haiti, entitled *My Earthquake Story,* are designed to "exercise that part of the brain in telling a more cohesive and coherent story," she says. Prompts encourage kids to write and draw about what they were doing when the quake struck, what happened to their homes, and whether they saw any people doing good deeds in the aftermath of the disaster, among other things. In essence, the workbooks ask the kids: "How can you rewrite this story in a way that makes sense to you?" Dell'Oliver says.

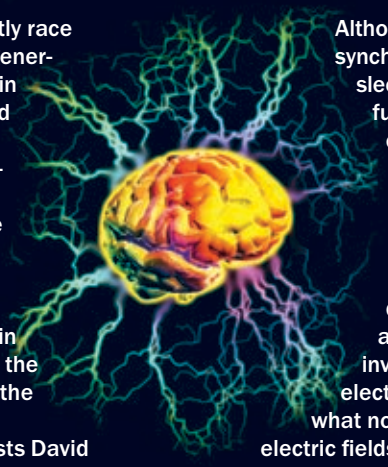
Although it is hard to collect good psychological data in active disaster zones, there is encouraging evidence that the approach is working. Mercy Corps has also developed workbooks for children affected by Hurricane Katrina, conflict in the Gaza Strip and other calamities. (Dell'Oliver tweaks the workbooks depending on the children's culture and the nature of the disaster.) A study of sixth through eighth graders displaced by Katrina revealed that the children who used the workbooks for 30 minutes every week experienced a nearly 20 percent reduction in PTSD symptoms. (The results have not yet been published but were presented at several scientific conferences.) When new disasters occur, Mercy Corps plans to be there, revising the workbooks once again to help a new set of kids in need.

—Emily Anthes

>> NEUROSCIENCE

Neural Feedback

The brain generates an electric field that influences its own activity



Your brain is electric. Tiny impulses constantly race among billions of interconnected neurons, generating an electric field that surrounds the brain like an invisible cloud. A new study published online July 15 in Neuron suggests that the brain's electric field is not a passive by-product of its neural activity, as scientists once thought. The field may actively help regulate how the brain functions, especially during deep sleep. Although scientists have long known that external sources of electricity (such as electroshock therapy) can alter brain function, this is the first direct evidence that the brain's native electric field changes the way the brain behaves.

In the study, Yale University neurobiologists David McCormick and Flavio Fröhlich surrounded a still-living slice of ferret brain tissue with an electric field that mimicked the field an intact ferret brain produces during slow-wave sleep. The applied field amplified and synchronized the existing neural activity in the brain slice. These results indicate that the electric field generated by the brain facilitates the same neural firing that created the field in the first place, just as the cloud of enthusiasm that envelops a cheering crowd at a sports stadium encourages the crowd to keep cheering. In other words, the brain's electric field is not a by-product; it is a feedback loop.

Although researchers knew that periods of highly synchronized neural activity (such as that of deep sleep) are crucial for maintaining normal brain function, exactly how these stable phases are coordinated—and why they go awry in disorders such as epilepsy—was never clear. The new study indicates scientists may find some answers in the surprisingly active role of the brain's electric field.

"I think this is a very exciting new discovery," says Ole Paulsen, a neuroscientist at the University of Cambridge who was not involved in the study. "We knew that weak electric fields could impact brain activity, but what no one had really tested before was whether electric fields produced by the brain itself could influence its own activity."

Fröhlich sees therapeutic applications as well, particularly in improving a promising technique called transcranial direct-current stimulation (tDCS), which applies weak electric fields to the scalp to treat, for example, depression and chronic pain. Traditionally tDCS uses standard electric fields that do not change much, as opposed to the dynamic electric fields used in the new study to mimic a living brain. "The next logical step is to use these more complex waveforms in a clinical setting and see if they improve the treatment," Fröhlich says.

—Ferris Jabr

>> BRAIN QUIRKS

Split Motivation

Why the left hand doesn't always know what the right is doing

Ever find yourself doing something without knowing exactly why? You might swat at a fly before you consciously realize it is there, or you might catch yourself scratching a bug bite you were trying to forget about. A new study published in *Psychological Science* could help explain why: half of the brain can be subliminally motivated while the other half is left in the dark.

Researchers at INSERM in Paris first measured how hard 33 subjects could squeeze a grip with each hand. Then they presented the subjects with images on a computer screen of either a one-euro coin or a one-cent coin. The coins were visible to only one eye at a time, and they appeared for only 17 milliseconds—long enough for subliminal, but not conscious, processing. After each coin image flashed, the subjects squeezed the grip with whatever hand they were holding it in—they were told they would win a fraction of the coin's value depending on the amount of effort they exerted. Each subject got to try all four possible combinations of eyes and hands: right eye with right or left hand and left eye with right or left hand.

Although the subjects could not correctly guess which coin they had seen—confirming that they were not conscious of what they saw—they squeezed harder when presented with the larger coin if the hand grip was on the same side of the body as the eye that had seen it. Their squeezes did not change depending on what the opposite eye saw, indicating that only half the brain was being motivated at a time. Motivation, therefore, is sometimes not only subconscious, explains co-author and INSERM cognitive neuroscientist Mathias Pessiglione, but it can also be "subpersonal," in that "one part of a person can be motivated while the other is not." So next time you are surprised to find yourself midaction, consider blaming it on the independent halves of your brain.

—Melinda Wenner Moyer

VICTOR HABBICK VISIONS/PHOTO RESEARCHERS, INC. (*top*); ISTOCKPHOTO (*bottom*)

>> PARENTING

When Mom Has Favorites

Children who receive unequal treatment are more likely to grow into depressed adults

Kids fare poorly when Mom plays favorites, but now a study from Cornell University has found that even adults may experience lasting effects from Mom's preferential treatment. The study, published in the *Journal of Marriage and Family*, found that people who grew up in homes where they perceived maternal favoritism were more prone to depression as adults. Strikingly, it didn't matter if they were the favored or unfavored child. "Favored children can experience guilt about their preferred status, extra demands from parents, and resentment from siblings," says Karl Pillemer, the lead author and a gerontologist at Cornell. *—Winnie Yu*

>> LONGEVITY

Old and Wise

Bees help to explain the link between intelligence and long life

Intelligent people live longer—the correlation is as strong as that between smoking and premature death. But the reason is not fully understood. Beyond simply making wiser choices in life, these people also may have biology working in their favor. Now research in honeybees offers evidence that learning ability is indeed linked with a general capacity to withstand one of the rigors of aging—namely, oxidative stress.

Ian Deary, a psychologist at the University of Edinburgh, has proposed the term "system integrity" for the possible biological link between intelligence and long life: in his conception, a well-wired system not only performs better on mental tests but is less susceptible to environmental onslaughts. Gro Amdam of Arizona State University and the Norwegian University of Life Sciences was intrigued by the idea and last year devised a way to test it in bees.

Honeybees are frequently used as a neurobiological model for learning—they can be trained, using positive or negative reinforcement, to retain information. In Amdam's experiment, individual bees were strapped into a straw, where they learned to associate an odor with a food reward in a classic Pavlovian conditioning scenario. After only one or two trials, many bees learned to stick out their tonguelike proboscis in anticipation of a sugary droplet. Some bees took a little longer—as in humans, there are quick learners and slower ones.

To simulate aging, the same bees were then placed in plastic tubes and exposed to a high-oxygen environment, a metabolic stress test. All animals need oxygen to breathe, but an overload drives cells to churn out damaging free radicals that break down cell membranes and cause cells to commit suicide, triggering premature aging. The better learners tended to live longer during this ordeal—an average of 58.8 hours, as opposed to the poor learners' average of 54.6—suggesting they have a more robust antioxidant system, which mops up destructive free radicals.

Amdam suspects that general stress resilience may explain why the quick learners lived longer. In the learning trials, the bees that could stand the stress of being in the straw were able to learn faster that the odor signaled a treat, and the same resilience allowed these bees to better withstand the stress of being in a high-oxygen environment.

For people, too, Amdam hypothesizes that the ability to handle stress could be a component of system integrity; better overall stress resilience may contribute to both higher IQ scores and longer life. And if scientists can unravel what underlies these biological differences, they might be able to alleviate inborn disparities. "There is an opportunity to help everyone live longer," Amdam says. *—Kirsten Traynor*

CORBIS (*top*); ANTAGAIN /iStockphoto (*bottom left*); ROB HOWARD Corbis (*bottom right*)

>> TECHNOLOGY

Something to Sniff At

A new device allows paralyzed people to communicate with their noses

Other than florists and allergy sufferers, most people don't do much sniffing. But scientists in Israel see the ability as a way to assist severely paralyzed people. In the August 10 issue of the *Proceedings of the National Academy of Sciences USA,* Noam Sobel and his team at the Weizmann Institute of Science in Rehovot described the first ever sniff-enabled device: a thin plastic tube with two short prongs that are inserted into the nostrils. The gadget measures nasal pressure and converts it into electrical signals that can be read by a computer. The researchers found that, by sniffing, people could quickly and accurately raise or lower their nasal pressure enough to trigger a command, similar to pressing a button.

The gadget detects sniffs with a tube that rests under the nose like this common nasal cannula.

When playing a computer game using the device, healthy users performed as well as they did with a handheld mouse or joystick—without fatiguing, as happens to hands during sustained play. A quadriplegic person learned after 15 minutes of practice to use patterns of sniffing to drive an electric wheelchair, and two out of three people with locked-in syndrome—marked by complete paralysis—were able to control their sniffing enough to use the device to select letters from a virtual keyboard. One of the locked-in people was able to communicate for the first time, and the other reported that the device was easier to use than the more established ones that monitor eye movement or blinks. Because the invention is cheap to make and not easily dislodged by motion, it could become widely available for people with disabilities. *—Michele Solis*

GETTY IMAGES (*top*); CORBIS (*bottom*)

>> MENTAL HEALTH

More Vitamin D Could Prevent Some Psychosis

Low levels in pregnant mothers may put babies at risk of developing schizophrenia

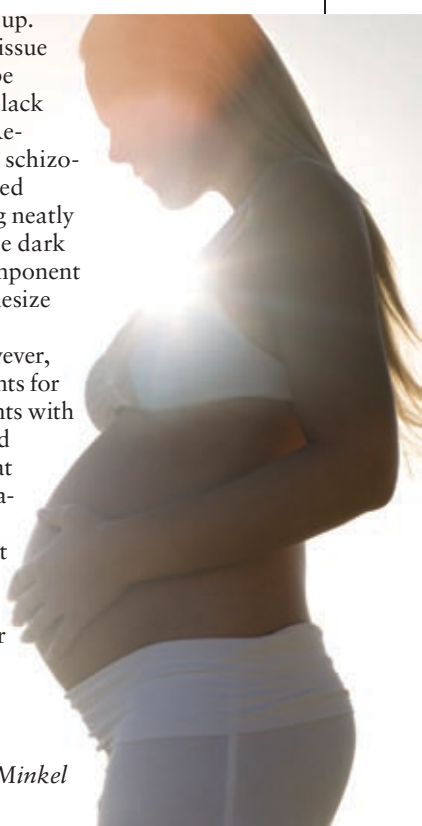
Could some cases of schizophrenia boil down to something as simple as vitamin D deficiency? The idea was first put forth more than a decade ago by schizophrenia researcher John McGrath of the University of Queensland in Australia. The circumstantial evidence fit: people born in winter or spring or at high latitudes are at slightly increased risk of developing schizophrenia, and vitamin D deficiency is also more common in winter months and at high latitudes because of lack of sunlight. It may be that a deficit of vitamin D leaves expecting mothers more vulnerable to illnesses such as influenza, which could in turn sensitize the maturing brain to stress-related damage later in life. [For more on how prenatal infections can lead to mental illness, see "Infected with Insanity," by Melinda Wenner; Scientific American Mind, April/May 2008.]

Now McGrath and his colleagues have put the hypothesis to the test. They analyzed blood samples taken from 424 Danish newborns who went on to develop schizophrenia as well as an equal number of babies who never acquired the disease. In each sample, they measured the amount of the chemical 25OHD, which the body converts into vitamin D. The researchers found that infants who had low levels of 25OHD in their blood—and therefore mothers who were deficient in vitamin D while they were pregnant—were at a higher risk of developing schizophrenia when they grew up.

The result, published in the September issue of *Archives of General Psychiatry,* could be especially interesting for communities of black immigrants living in northern countries. Researchers have found a striking increase in schizophrenia risk for the children of dark-skinned migrants living at high latitudes—a finding neatly explained if vitamin D plays a role, because dark skin blocks ultraviolet B radiation, the component of sunlight necessary for the body to synthesize vitamin D.

There are some loose ends to tie up, however, before recommending vitamin D supplements for at-risk mothers. The group found that infants with *high* levels of 25OHD were also at increased schizophrenia risk. McGrath speculates that these infants might have been relatively incapable of generating vitamin D, leading to a buildup of the precursor in their blood—but more research is necessary to say for sure. All told, 44 percent of the schizophrenia cases in the study were attributable to either low or high vitamin D levels. "Even if vitamin D supplements can prevent only a small fraction of schizophrenia," McGrath says, "it will be a fantastic outcome."

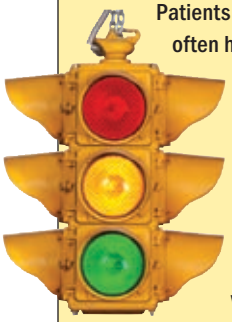
—JR Minkel



>> NEURODEGENERATION

Stop and Go

New work uncovers neurons that start and end an action



Patients with Parkinson's disease often have trouble with walking. Either they cannot take the first step, or they cannot stop moving when they reach their destination. The problem is not with the steps themselves but with starting and stopping the action—a pervasive difficulty that affects every aspect of daily life. Now research has finally pinpointed the neurons in the brain that initiate and end movements.

Rui Costa of the Champalimaud Neuroscience Program in Portugal and Xin Jin of the National Institutes of Health designed a task for mice that was the equivalent of taking eight steps. If the mice pressed a bar exactly eight times, no more, no less, they received a reward. Costa and Jin implanted tiny electrodes in each mouse's brain to record the activity of neurons within the striatum, a structure deep in the brain known to be involved in motor commands. They found that some neurons became active right before the mouse started to press the bar and other neurons became active right before stopping.

To confirm that these neurons were indeed responsible for starts and stops, the researchers then genetically altered mice to lack the neurons, and subsequently the mice could not learn the task. They were slow to begin pressing the bar, and they tended to randomly stop in the middle of the task. These mice did not have trouble with movements per se, Costa explains, but like people with Parkinson's or Huntington's disease, with starting and stopping a task properly. The work should help scientists understand precisely what goes wrong in the brains of patients and help them design better therapies, Costa says.

—Carrie Arnold

DIETER SPEARS *iStockphoto (left)*; JOHN-FRANCIS BOURKE *Corbis (right)*

>> THE SUBCONSCIOUS MIND

Telltale Heart

A test of hidden attitudes predicts relationship decay

Sometimes it's easy to tell when a romantic relationship is about to take a dive. It doesn't bode well if you would rather sort socks than go out on a date or if neither of you can think of much to say. Another bad sign is when—consciously or not—you associate your lover with words like "death" and "attacking."

In a recent study using a word-association task, psychologists at the University of Rochester asked 222 men and women—all of them married, engaged or in committed relationships—to do some computerized word-sorting. As quickly as they could, participants paired their romantic partners' names and distinctive characteristics with either positive words such as "peace" and "caring" or negative words such as "nagging" and "criticizing."

The task is designed to tap into people's "implicit" feelings—attitudes they may be unable or unwilling to explicitly acknowledge. Results showed that the more often individuals flubbed their responses to pairings of partner-related words with positive words, the more likely they were to have broken up a year later—even when variables such as relationship satisfaction and conflict were taken into account. Across two experiments using slightly different kinds of words, participants who performed both below average on positive partner pairings and above average on negative partner pairings had a 70 to 75 percent likelihood of breaking up within a year, compared with only 11 to 14 percent of other participants.

These results suggest that implicit negative attitudes toward a romantic partner may reflect early misgivings and gripes that are either too subtle to consciously recognize or too distressing to admit—but you can't ignore your subconscious forever.

—Siri Carpenter

The "Me" Effect

You have a powerful influence on other people's moods

BY NICOLE BRANAN

People who are both extroverted and disagreeable tend to make everyone around them feel bad.

ANDREAS KUEHN *Getty Images*

ELVIS PRESLEY'S mere presence caused teenage girls to scream and faint by the dozens. Charismatic leaders such as Mahatma Gandhi and Martin Luther King, Jr., have been known to inspire entire nations, whereas so-called toxic individuals make life hell for anyone who comes close. There is no shortage of examples of people who have an undeniable influence on everyone around them, but the common wisdom has been that such individuals are rare. An intriguing new study, however, suggests the opposite: everyone seems to have a tangible impact, changing other people's feelings in consistent ways.

For years much of the research on personality and emotion has focused on a phenomenon known as trait affect—a person's habitual feeling state. Everyone experiences a range of emotions—anger, sadness, happiness—but people usually fall back pretty quickly to their emotional baseline. For example, some individuals tend to feel relaxed regardless of what comes their way, while others are almost always anxious. Two organizational behavior scientists, Noah Eisenkraft, now at the University of North Carolina at Chapel Hill, and Hillary Anger Elfenbein of Washington University in St. Louis, designed a study to investigate whether people also have a predictable influence on *other* people's moods. "I kept hearing about this terrible boss or this horrible co-worker, and I started thinking that we didn't really have anything in personality psychology that I could use to explain this," Eisenkraft says.

No one needs a study to tell them that they feel good when interacting with some people and bad around others. But the striking conclusion of this research is that without trying or even being aware of it, each person gives out a vibe—the researchers dubbed it "trait affective presence"—that affects everyone they come into contact with in the same way. So much so that certain emotions—notably discouragement, frustration and stress—are "influenced as much by who you are interacting with as by who you are," Eisenkraft says. Positive emotions such as enthusiasm and happiness, meanwhile, are less influenced by others. Another surprising finding: people's own character traits do not always predict the emotional effect they have on others. For example, happy people can be downers. The research was published in April in the journal *Psychological Science*.

In the past when psychologists explored the emotional impact people have on one another, they engineered interactions among strangers in the laboratory. Eisenkraft and Elfenbein wanted to examine a real-world setting similar to the ones that people experience daily—at work, the supermarket, the doctor's office. They decided to follow 239 business school students who were assigned as part of their studies to small teams to work on projects. After the teams had been together for a month, the researchers asked the students how much of eight emotions they felt—angry, bored, calm, enthusiastic, happy, relaxed, sad and stressed—when they were around each of their partners. If most of the students gave the same response to a single person—for example, "I felt stressed-out"—it was an indication that that person likely had a strong influence, or trait affective presence.

To avoid confounding factors, the

People's character traits do not always predict the effect they have on others: **happy people can be downers.**

Charismatic leaders have a consistent and unusually strong impact. President Lyndon B. Johnson (*right*) was known for clinching votes through intimidation when his pugnacious charm failed. After overcoming childhood shyness, Gandhi (*below*) cultivated a gentler but equally persuasive style.

psychologists filtered out something called emotional contagion. This is a common phenomenon in which people infect others with their moods of the moment—a person who feels cheerful buoys confederates, while one who feels sad depresses them. Trait affective presence, in contrast, is the tendency to consistently elicit the same emotions in everyone around you, regardless of what mood you happen to be in.

Rose-Colored Responses?

What kinds of people were most likely to affect others? The students who, in a preliminary personality assessment, described themselves as both "extroverted" and "disagreeable" were more likely to have a negative effect on their teammates. This effect was so strong that simply being around them contributed as much to their teammates' feelings as did the teammates' own inherent mood set points. But surprisingly, the investigators found no links between any other personality traits and emotional impact. For example, altruistic and kind people were equally likely to make their teammates anxious as to make them feel relaxed.

The results suggest that "people can be categorized based on the way they make others feel," Eisenkraft and Elfenbein wrote, but more work is necessary. Paul Spector of the University of South Florida cautions that the data might reflect experiences the business school teams shared, as opposed to the people themselves. Say, for example, that one team member took the lead on a project and the group got a good grade. That might have rose-colored the emotional response to that person. And to be certain that trait affective presence exists, scientists would have to show that it is stable over time, says John Schaubroeck of Michigan State University. It would be important to show that the students who, for instance, made their teammates feel relaxed elicited the same response two or five years from now, he noted.

Most people do not know what their own trait affective presence is, according to unpublished research by Eisenkraft. "It's not very easy to detect, because you don't actually get to see what the world is like when you are not around," he says. Also unknown is the way trait affective presence is communicated. How do people elicit consistently good or bad feelings in others? Is it their nonverbal cues? The amount of warmth they show to others? Any insights will be valuable, because the phenomenon is apparently so universal. And whereas hundreds of studies have been done on people's emotional baselines, showing their influence on everything from satisfaction to whether a person tends to be late to work, Eisenkraft points out, "here I am looking at an effect that is equal in magnitude that we know nothing about." M

NICOLE BRANAN is a freelance writer and photographer based in Colorado.

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GEORGE TAMES *New York Times/Redux Pictures (Lyndon B. Johnson);*
WALLACE KIRKLAND *Time & Life Pictures/Getty Images (Gandhi)*

Dream States

Although we rarely remember our nighttime reveries, they may hold the key to consciousness

BY CHRISTOF KOCH

In Christopher Nolan's film *Inception,* an architecture student designs nested environments in which people's dreams will take place. In this scene, a city street folds in on itself.

CHRISTOF KOCH (*Koch*); WARNER BROS/THE KOBAL COLLECTION (*Inception*)

IF YOU HAVE SEEN the recent Hollywood blockbuster *Inception,* a movie that does to dreaming what *The Matrix* did for virtual reality, you may have been holding your breath as Ariadne, an architecture student, folded the streets of Paris over herself like a blanket. This stunning sequence, an homage to M. C. Escher, is testimony to the bizarre nature of dreams. Watching it made the neuroscientist in me reflect on what dreams are and how they relate to the brain.

The first question is easy to answer. Dreams are vivid, sensorimotor hallucinations with a narrative structure. We experience them consciously—seeing, hearing and touching within environments that appear completely real (though curiously, we do not smell in our dreams). Nor are we mere passive observers: we speak, fight, love and run.

Dream consciousness is not the same as wakeful consciousness. We are for the most part unable to introspect—to wonder about our uncanny ability to fly or to meet somebody long dead. Only rarely do we control our dreams; rather things happen, and we go along for the ride.

Everyone dreams, including dogs, cats and other mammals. But sleep lab data reveal that people consistently underreport how often and how much. The reason is that dreams are ephemeral. Memory for dreams is very limited and largely restricted to the period before awakening. The only way to remember a dream is to immediately recall it on waking and then write it down or describe it to another person. Only then does its content become encoded in memory.

Although we often have trouble remembering dreams, our dreaming selves have full access to our pasts. In dreams we recall earlier episodes from our lives, and we often experience intense feelings of sadness, fear, anxiety or joy. Perhaps it was this heightened emotionality that led Sigmund Freud to speculate that dreams serve as wish fulfillment. Regardless, the answer to my second question—how and why does the brain manufacture dreams?—remains a fundamental mystery. But psychologists and brain scientists have recently renewed their interest in this everyday surreal activity.

Perchance to Dream

In 1953 Nathaniel Kleitman of the University of Chicago and his graduate student Eugene Aserinsky discovered that slumber, which had been considered a single continuous period of downtime, contains recurring periods in which the sleeper's eyes move about, heartbeat and breathing become irregular, most voluntary muscles are paralyzed and brain activity (as measured by electroencephalography) is heightened. These fast, low-voltage brain waves resemble the ones that occur during wakefulness. This state became known as rapid eye movement (REM) sleep, to distinguish it from deep sleep.

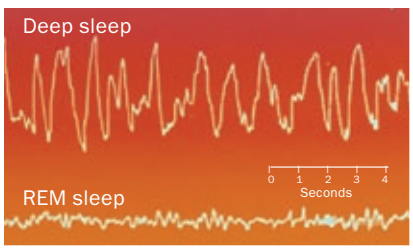
When people are woken from REM sleep, they usually report vivid dreams. Such reports do not occur when people are roused from non-REM sleep. Thus arose the close association between REM sleep and the oneiric state. For many years experts associated dream consciousness with the distinct physiology of the brain during REM sleep.

But in the past several decades that understanding has begun to slowly shift. When people who are woken from deep sleep are asked "What was passing through your mind just before you woke up?" rather than the more biased "Have you been dreaming?" a more nuanced picture emerges.

In the early phases of deep sleep, and during short daytime naps, which consist of pure non-REM sleep, people re-

Dreaming supports the old philosophical **brain-in-the-vat idea** that saw its modern renaissance in *The Matrix*.

port vivid hallucinations that are shorter, more static and more thoughtlike than the dreams that occur during REM sleep. These visions are typically more like snapshots than narratives and do not include a self. Yet a minority of non-REM dream reports are indistinguishable from REM dreams. It is also notable that sleepwalking and nightmares occur in deep, not REM, sleep. Thus, scientists have had to revise the belief that the REM state is an external manifestation of the subjective dream state.



Brain waves are slow and even during periods of deep sleep and faster and more variable during REM sleep. Early research linked dreams to REM sleep, but scientists now know that dreams occur in both states.

Further evidence comes from the study of brain-damaged patients by neuropsychoanalyst Mark Solms of the University of Cape Town in South Africa. When a part of the brain stem known as the pons is destroyed, people no longer experience REM sleep. But only one in 26 of such patients reports a loss of dreaming, and nobody has ever reported loss of dreaming from limited pons damage.

The regions critical for dreaming are not in the pons. They include the visual and audiovisual regions in and near the temporoparietal-occipital junction in the neocortex. Destruction of small portions of these areas leads to the loss of specific dreaming dimensions. For example, a stroke, tumor or other calamity in the cortical region necessary for color or motion perception will leach hue or movement from dreams.

Moreover, medications that manipulate dopamine levels strongly affect dreaming while leaving the REM sleep cycle unaffected. L-dopa, the most popular medication for Parkinson's disease, increases the frequency and vividness of dreams, whereas antipsychotic drugs that block dopamine reduce dreaming.

The dissociation of dreaming from REM sleep serves as a conceptual clearing of the deck for neuroscientists such as myself. Now we can focus on the neuronal causes of conscious mental activity, whether in a dreaming or wakeful state, without being confused by extraneous factors such as REM or non-REM sleep that, it turns out, do not pertain to subjective experience per se.

The Mind-Body Problem

Why am I so confident I experience anything while dreaming? Maybe I am unconscious while slumbering and confabulate my dreams when I awaken.

This is unlikely for many reasons. The bizarreness and vividness of dreams are distinct from normal experience and therefore unlikely to be "retrofitted." Indeed, people with memory deficits do not report fewer dreams. Additionally, the length of dream reports correlates well with time elapsed in REM dreams.

More evidence comes from people with REM sleep behavior disorder, who lack the muscle paralysis, known as atonia, typical of REM sleep. They act out their dreams, sometimes even harming themselves or bed partners, and their actions match their dream reports. They might, for instance, move their legs while asleep and later report that they dreamed of walking.

Dreams are of great interest to the student of the mind-body problem, because they bear witness that the brain alone is sufficient to generate consciousness. We dream with eyes shut in the dark, disconnected from the outside world. The brain regions responsible for basic sensory perception are deactivated. Nor is behavior necessary, as we are motionless except for our breathing and eye movements. Thus, dreaming supports the old philosophical brain-in-the-vat idea that saw its modern renaissance in *The Matrix*.

Cognitive neuroscientists have recently learned to decode some simple mental states—in essence, a primitive form of mind reading. When scientists ask people to view one of two images—a portrait or a photograph of a house—or to imagine either a face or a house, they can tell from brain analyses which of the two the person is seeing or imagining.

Once such techniques become more sophisticated, they could be put to use in dream work, so that in addition to studying the physiology of the dreaming brain, investigators will be able to read out the content of the dream itself. Then neuroscience will be in a much better position to answer the age-old questions that have fascinated everyone from oracles and shamans to Freud and, more recently, science-fiction enthusiasts: Why do we dream, and what do dreams mean? M

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Hungry for Meaning

The brain recognizes food-based illusions on multiple levels

BY SUSANA MARTINEZ-CONDE AND STEPHEN L. MACKNIK

MUSEO CIVICO ALA PONZONE, CREMONA, ITALY/THE BRIDGEMAN ART LIBRARY (*Arcimboldo*); KUNSTHISTORISCHES MUSEUM, VIENNA, AUSTRIA/THE BRIDGEMAN ART LIBRARY (Summer)

ARE YOU IMPRESSED with meals that look like one food but are actually made of something else? Tofu burgers and artificial crabmeat, for example, are not what they appear to be, yet the masquerade half-convinces our taste buds all the same.

Such ruses have a venerable history. In medieval times fish was cooked to imitate venison during Lent, when it was customary to abstain from meat and other indulgences. At all times of the year, celebratory banquets included extravagant (and sometimes disturbing) delicacies such as meatballs made to resemble oranges and shellfish made into mock viscera. Recipe books from the Middle Ages and the Renaissance also describe roasted chickens that appeared to sing, peacocks redressed in their own feathers and made to breathe fire, and a dish aptly named Trojan hog, in which a whole roasted pig was stuffed with an assortment of smaller creatures such as birds and shellfish, to the amusement and delight of cherished dinner guests.

Food illusions don't appeal only to the palate. Some exploit quirks of our neurological wiring to confuse and entertain both the eyes and mind.

Take this still life by Italian painter Giuseppe Arcimboldo (1527–1593), which depicts the ingredients for his favorite minestrone soup (*top left*). Turned upside down (*top right*), Arcimboldo's bowl of vegetables becomes a whimsical

Why do we see a face in the arrangement, when we know it is a **bunch of vegetables?** And why only when the image is flipped?

portrait of a man's head, complete with a serving-bowl hat.

This image raises a couple of questions. First, why do we see a face in the arrangement, when we know that it is just a bunch of vegetables? Our brains are hardwired to detect, recognize and discern facial features and expressions using only minimal data. This ability is critical to our interactions with other people and is the reason that we perceive personality and emotion in everything from crude masks to the front ends of cars.

Second, why do we see the face only when the image is flipped? The same brain mechanisms that make face processing fast and effortless are optimized to recognize faces the way we generally see them—right-side-up—so upside-down ones are harder to recognize.

A Lot to Digest

Arcimboldo's work demonstrates that, neuroscientifically speaking, the whole is more than the sum of its parts. Clever arrangements of individual fruits, flowers and legumes become exquisite portraiture when viewed in their entirety, such as in the likeness of the Hapsburg emperor Rudolf II, here depicted as Vertumnus, the Etruscan god of transformations (*opposite page, bottom*).

The brain builds representations of objects from line segments and tiny patches of color, then identifies them for what they are by comparing them to a mental library of similar visual images. The viewer first makes out a bulbous protrusion in the middle of Rudolf's face because thousands of retinal photoreceptors in the eye react to the various shades of color and luminance in that area of the painting. There are no retinal cells specialized in recognizing noses, however. That next step occurs when high-level neuronal circuits in cognitive areas match the information to the brain's stored template for noses, created from a lifetime's experience of viewing them.

In this case, the output from those same photoreceptors also activates the high-level object-tuned neurons that recognize fruits, which is what makes images such as these so much fun to look at. A nose is a nose is a nose, to riff on Gertrude Stein—except when it's a pear.

Such visual puns, artfully constructed, appeal to the mind as much as any wordplay. For example, in this image of a hummingbird (*above*) the brain simultaneously detects animal features (eyes, wings, tail) along with plant parts (eggplant, artichoke leaves). This dual spark of recognition, with all its contradictions, tickles the fancy.

Delicious Deceptions

The dots that compose this image of a cherry-topped cupcake (*left*) are multicolored jelly beans, a technique that recalls the works of painters such as Georges Seurat and Paul Signac. The pointillists juxtaposed multiple individual points to create hues that were very different—when viewed at a distance—from the actual colors of the painted dots.

But in a very real sense, all art is pointillism. In fact, all visual perception is pointillism. Our retinas are sheets of photoreceptors, each sampling a finite circular area of visual space. Every photoreceptor then connects to downstream neu-

VANESSA DUALIB (*hummingbird*); KRISTEN CUMINGS *Jelly Belly Candy Company (cupcake)*

CARL WARNER

ral circuits that build our perception of objects, faces, loved ones and everything else. Thus, vision itself is largely a pointillist illusion, colored by a tremendous amount of "guesstimation" and filling in on the part of the brain. It doesn't matter whether a painter uses brushstrokes or candy or whether the "artist" is the sun illuminating the world; the effect is the same—colors, lines, shadows, reflections are processed by the brain to become everyday objects.

Among artists who play with food are those who challenge the brain by changing the scale. Instead of constructing something small (a cupcake) from even smaller items (jelly beans), they build sweeping views. The image above looks, at first sight, like a landscape painting. But examine it more closely. These are actual foods laid out to re-create details of scenery and terrain. London photographer Carl Warner arranges meats, cheeses and vegetables to create environments that could be the setting of a Brothers Grimm fairy tale, then photographs the scene in layers from foreground to background to create a composite image.

Warner's work takes food-based visual illusions to the next level in that here real foods not only represent other things but are juxtaposed in such a way that their various sizes create the illusion of perspective. Some vegetables, for example, appear to recede into the distance: green chili and Romano peppers become cypress trees (the larger Romano peppers placed in the foreground to create the effect), pine nuts are stones for walls, and mozzarella cheese, clouds. The brain recognizes a delicious assortment of Italian edibles, as well as a Tuscan hillside, in the same visual data. Food for thought, indeed. **M**

SUSANA MARTINEZ-CONDE and STEPHEN L. MACKNIK are laboratory directors at the Barrow Neurological Institute in Phoenix. They are authors of the new book *Sleights of Mind: What the Neuroscience of Magic Reveals about Our Everyday Deceptions,* with Sandra Blakeslee [for an excerpt, see "Mind over Magic?" on page 22].

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(calendar)

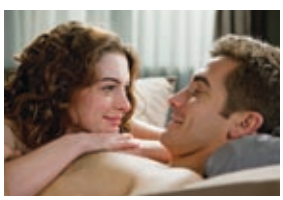
November

11–12 Researchers agree that genetic factors are a predominant cause of autism. Yet each new gene accounts for only about 1 to 2 percent of all cases. Now mounting evidence suggests that many of these defective genes fall along a brain pathway where key neural connections develop. At a two-day meeting sponsored by the journal *Brain Research,* **The Emerging Neuroscience of Autism Spectrum Disorders,** scientists will discuss how these insights can help trace the disorder's genesis and spur novel treatment strategies.
San Diego
www.brainresearch2010.com/programme.asp

13–14 Over the past three years IBM scientists have developed a robot called Watson that can defeat human contestants at *Jeopardy!* Watson's ability to decode puzzling questions depends on intricate computer algorithms that mimic how the human brain processes language and information. At the two-day **First International Conference on Biologically Inspired Cognitive Architectures**, researchers will discuss other potential applications of such artificial intelligence. For instance, robots may someday do chores around the house or inspect electrical equipment on airplanes.
Arlington, Va.
http://bicasymposium.com

VOLKER STEGER *Photo Researchers, Inc. (robotic head);* 20TH CENTURY FOX *(Love and Other Drugs);* J. B. SPECTOR *Museum of Science and Industry (YOU! exhibit)*

24 ***Love and Other Drugs,*** a film by Edward Zwick, director of the 2006 film *Blood Diamond,* depicts an artist named Maggie (Anne Hathaway) in the early stages of Parkinson's disease. Instead of crumbling from the devastating news, she displays a positive attitude and relentless spirit. In fact, Maggie copes with her own fate by helping a distraught Viagra salesman (Jake Gyllenhaal) find a sense of purpose in life.
Nationwide
www.imdb.com/title/tt0758752



December

19 On this day in 1967 magician **Criss Angel** was born. Angel stars in the television show *Criss Angel Mindfreak*, which debuted in 2005, where he showcases stunning illusions in front of live audiences. His tricks have included mind-reading card tricks, walking on water and levitating above a hotel. He has also paid homage to legendary Harry Houdini's Chinese Water Torture Cell trick, in which Houdini was lowered into a tank of water and had to escape shackles and chains before drowning. In this issue of *Scientific American Mind,* discover the neuroscience behind infamous tricks performed by some of the world's best illusionists [see "Mind over Magic?" on page 22].

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

Playing with Your **Mind**

Several interactive museum exhibits showcase how your brain responds to its surroundings.

Starting November 20

What if you could step inside your head and walk through your brain? The American Museum of Natural History invites you to explore the nooks and crannies of our most complicated organ in a new exhibit, called **Brain: The Inside Story**, that will run until August 14, 2011. Observe how the brain continually changes with age and navigate a tangle of interconnected neurons to see how they communicate with one another.
New York City
www.amnh.org

Often music demands a response from our bodies, whether it's toe-tapping or unbridled swing dancing. Music engages the entire brain, from areas devoted to sounds and language to those dedicated to vision and even touch. The San Francisco Museum of Modern Art's new exhibit **Sonic Shadows**, which will run until October 16, 2011, takes advantage of our rich experience of music. One interactive display transforms a steel pedestrian bridge into a musical instrument, using sensors to detect the tiny vibrations from your footsteps and change them into a symphony as you walk.
San Francisco
www.sfmoma.org/exhibitions/416

Ongoing

Have you ever felt compelled to run out and buy a new brand of yogurt, laundry detergent or lipstick after watching a television advertisement for it? At the Chicago Museum of Science and Industry exhibit ***YOU! The Experience,*** you will create your own commercial and learn the subtle psychological tactics that make these ads so persuasive. You can also track your eye movements to see which objects catch your attention, and why, and rotate a virtual brain to discover which regions control learning and memory.
Chicago
www.msichicago.org

Mind *over* Magic?

Magicians dazzle us by exploiting loopholes in the brain's circuitry for perceiving the world and paying attention

By Stephen L. Macknik and Susana Martinez-Conde, with Sandra Blakeslee

Apollo Robbins, master pickpocket and celebrity magician, is sweeping his hands around the body of the fellow he has just chosen from the audience. "What I'm doing now is fanning you," he informs his mark, "just checking to see what you have in your pockets." Apollo's hands move in a flurry of gentle strokes and pats over the man's clothes. More than 200 scientists are watching him like hawks, trying to catch a glimpse of fingers trespassing into a pocket. But to all appearances this is a perfectly innocent and respectful frisking. "I have a lot of intel on you now," Apollo continues. "You scientists carry a lot of things."

Apollo is demonstrating his kleptic arts to a roomful of neuroscientists who have come to Las Vegas for the 2007 Magic of Consciousness Symposium. Magicians and neuroscientists share a passion for understanding the nuts and bolts of the human mind, but we have been developing our respective arts and theories more or less independently of each other for generations. Starting tonight, if all goes as planned, our two communities are going to pay close attention to each other's discoveries.

As vision scientists, we have spent the past few years traveling the world, meeting magicians, learning tricks and inventing the science of "neuromagic." Magic tricks work because humans have a hardwired process of attention and awareness that is hackable. By understanding how magicians hack our brains, we can better understand how the same cognitive tricks are at work in advertising strategy, business negotiations and all varieties of interpersonal relations.

Magicians distract and fool an audience by surreptitiously manipulating people's attention, tricking them into focusing on irrelevant objects or occurrences and into making incorrect assumptions about the purpose of an action. These artists construct various types of cognitive illusions [*see box on page 27*] that make it impossible for the uninitiated to follow the physics of what is actually happening. As a result, observers get the impression that there is only one explanation for what just took place: pure magic.

AARON GOODMAN

Apollo Robbins, the infamous "gentleman thief," manipulates people's attention in clever ways to prevent them from noticing when he absconds with their wallets, watches, keys, eyeglasses and cash.

Cognitive Feints and Jabs

Apollo has dared everyone in the auditorium to try and catch him pilfering this man's belongings. We watch intently, but none of us really stands a chance. This is Apollo Robbins, the infamous "gentleman thief" who once pickpocketed ex-president Jimmy Carter's Secret Service detail, relieving them of their watches, wallets, badges, confidential itinerary and the keys to Carter's limo. But as soon as we see whom Apollo has plucked randomly from the crowd, we exchange amused glances. This man isn't a scientist at all, as Apollo assumes, but *New York Times* science reporter George Johnson.

The fanning continues as Apollo engages in his highly honed rapid-fire patter. "You have so many things in your pockets I'm not sure where to begin. Here, was this yours?" he asks, thrusting something into George's hand. George frowns down at it. "You had a pen in here," Apollo says opening George's breast pocket, "but that's not what I was looking for. What's in that pocket over there?" George looks over. "There was a napkin or a tissue, maybe? You have so many things it's confusing to me. You know, to be honest I'm not sure that I've pickpocketed a scientist before. I've never had to do indexing as I went through someone's pockets."

Patter is one of the most important tools in the magician's toolkit for attention management. There are only a dozen or two (depending on whom you ask) main categories of effects in the magician's repertoire; the apparent wide variety of tricks is all in the presentation and details. Sleight of hand is of course critical to a pickpocket, but so is patter—the smooth and confident stream of commentary that can be used to hold, direct or divide attention. Apollo tells George one thing while doing two other things with his hands. This means that in the best-case scenario George has only a one-in-three chance of noticing when something of his gets snatched. His real chances are actually far below one in three: in the psychic sparring ring of attention management, Apollo is a 10th-degree black belt. By continually touching George in various places—his shoulder, wrist, breast pocket, outer thigh—he jerks George's attention around the way a magnet draws a compass needle. While George is trying to keep track of it all, Apollo is delicately dipping his other hand into George's pockets, using his fast-driving voice to help keep George's attention riveted on Apollo's cognitive feints and jabs and away from the pockets being picked.

FAST FACTS

Shifting Focus

1» Humans have a hardwired process of attention and awareness that is hackable.

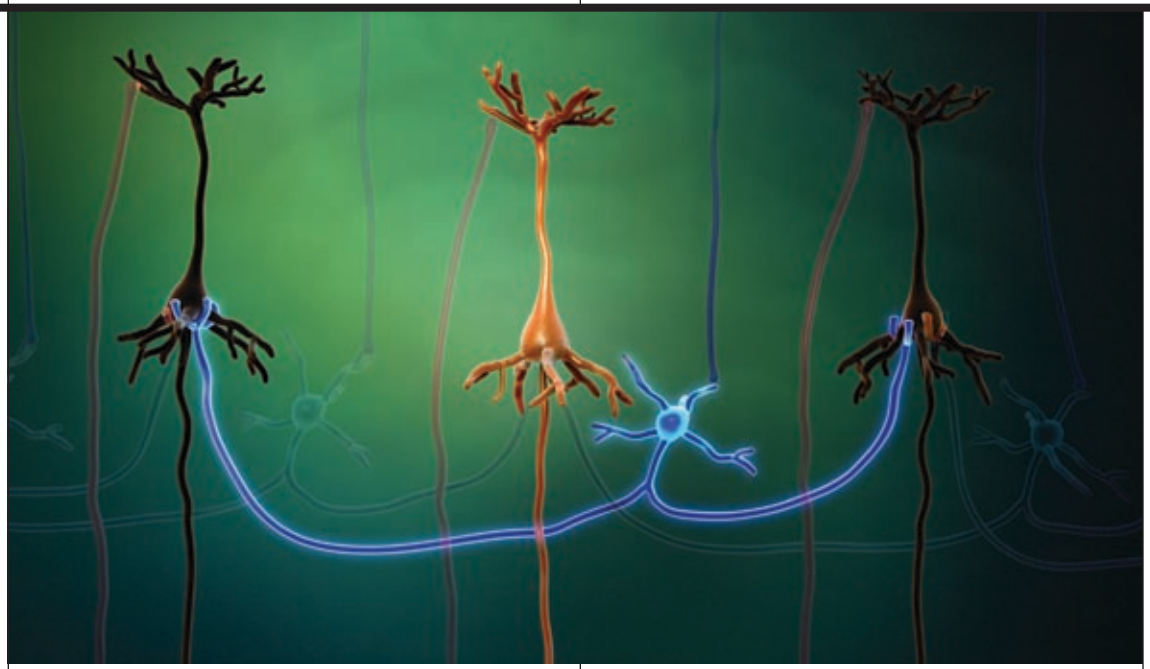
2» When people focus on one thing, their brains automatically suppress everything that happens around it. Magicians have devised many techniques that exploit this "tunnel vision."

3» People can pay attention in various ways. Magicians exploit "top-down," or deliberate, attention by, say, asking a person to scan a book. They capture "bottom-up" attention with distracting displays such as doves fluttering out of a hat.

SPOILER ALERT!
The following section describes magic secrets and their brain mechanisms!

Apollo steals George's pen, notes, digital recorder, some receipts, loose cash, wallet and, very early on, his watch. One classic way to lift somebody's watch is to first grab their wrist over the watchband and squeeze. This creates a lingering sensory afterimage, a tactile one in this

COURTESY OF APOLLO ROBBINS (*Apollo Robbins*); PETER STACKPOLE *Time & Life Pictures/Getty Images* (*wristwatch trick*)



When something grabs your attention—say, you spot a friend across the street—the specific neurons governing perception of that region of visual space (*orange*) become activated. Simultaneously, inhibitory neurons (*blue*) suppress the nearby brain cells responsible for perceiving surrounding areas (*dark brown*). Thus, paying attention to one thing makes it harder to notice what is around it: while you are focusing on your friend, you will fail to notice the cat slinking past you on the sidewalk.

COURTESY OF THE BARROW NEUROLOGICAL INSTITUTE

case. The afterimage renders the touch neurons in George's skin and spinal cord less sensitive to the watch's removal and creates a conveniently lasting perception of the watch long after it has disappeared. George simply doesn't notice his watch is missing because his skin tells him it is still there. We notice the watch when we see Apollo folding his arms behind his back, buckling it onto his own wrist as his patter leads George down some new garden path of attention.

END OF SPOILER ALERT

A few times during the fleecing Apollo holds up a pilfered object high behind George's head for the audience to see. This makes everyone but George laugh, who smiles and looks around sheepishly, wondering what the joke is. Then, to more laughter, Apollo returns all George's belongings one by one. Finally, he turns to George and says, "We all pitched in to buy you a watch, very similar to the one you were wearing when you got here." He unstraps George's watch from his own wrist and passes it over. George gasps and then rolls his eyes. How could he be so inattentive?

Dissecting Attention

Possibly the best definition of attention was put forth in 1890 by William James, the philosopher king of modern psychology. He wrote: "Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others."

By continually touching George in various places—his shoulder, wrist, breast pocket, thigh—Apollo jerks George's attention around the way a magnet draws a compass needle.

Since James's day, neuroscientists have learned that attention refers to a number of different cognitive processes. You can pay attention to your TV show voluntarily, which is one process (top-down attention), or your baby's crying can draw your attention away from the TV, a different process (bottom-up attention). You can look right at what you are paying attention to (overt attention), or you can

(The Authors)

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look at one thing while secretly paying attention to something else (covert attention). You can draw somebody's gaze to a specific object by looking at it (joint attention), or you can simply not pay attention to anything in particular. Some of the brain mechanisms controlling these processes are beginning to be understood. For example, you have a "spotlight of attention" that restricts how much information you can take in from a region of visual space at any given time. When you attend to something, it is as if your mind aims a spotlight onto it. You actively ignore virtually everything else, giving you a kind of "tunnel vision." Magicians exploit this feature of your brain to maximum effect.

It is not yet clear whether there is a single center in your brain that controls attention. Given the many types of attention, multiple attention-control centers may work in concert. One critical clue is that many of the same brain circuits that control your eye movements are involved with changing the location of your attention in the world. Eye movement circuits are responsible for orienting your eyes to specific areas of visual space, so it seems logical that those same circuits could orient your attentional spotlight, too. Determining what is interesting in the world is undoubtedly critical to deciding where you should look next. Magicians intuitively grasp this and control your eyes and your attention as if they were marionettes on a string.

Magicians may actively misdirect a person's attention toward a random object—say, asking him or her to identify the year on a quarter—so that they can perform another action unnoticed.

GETTY IMAGES

"Try these glasses," Apollo offers as he hands you the glasses off his face. Your own glasses, it turns out. While you were focused on the quarter, Apollo took the glasses from your pocket.

Attention is also linked to your short-term memory and your ability to tune out your focus on what is happening around you. Sometimes a stimulus is so demanding, so salient, that you cannot help but pay attention—an ambulance siren, an infant's cry, a dove fluttering out of a top hat. This information flows in a bottom-up fashion—from your primary senses to higher levels of analysis in your brain. It is called sensory capture.

Other times you can shift your attention around, as you choose, in a top-down fashion. Signals flow from your prefrontal cortex (the CEO of your attentional networks) to other regions that help process information. You don't hear the siren or baby or see the dove, because you are attending to something else, such as the last page of that fabulous mystery novel you are reading. Research shows that the greater your capacity for short-term or working memory, the better you are at resisting sensory capture.

Neuroscientists have begun to dissect the nature of attention and identify its neural correlates. The initial brain areas that process a visual scene use circuits that lay out visual space like a map. When you decide to consciously pay attention to a specific location of this "retinotopic" space, neurons from higher levels of your visual system increase the activation of the low-level circuits and enhance their sensitivity to sensory input. At the same time, neurons in the surrounding regions of visual space are actively inhibited. We recently worked with a group led by neuroscientist Jose-Manuel Alonso of the S.U.N.Y. State College of Optometry and showed that the neurons in the primary visual cortex not only exhibited this center-surround pattern of activity during

Mental Marksmanship

Magicians employ psychologically sophisticated tactics to train the focus of an audience away from the real action, enabling them to perform "magical" moves behind an audience's back—or, more often, right in front of its eyes. Their mental maneuvers include:

Afterimages. Magicians may poke or press a person to simulate the presence of an imaginary object they say they are providing or a real one they intend to remove, leaving the impression that the object is on the body when it isn't.

Patter. By engaging in chitchat, the magician fills an observer's mind with irrelevant information, creating confusion that distracts from the action.

Passive misdirection. Bright, new, moving or flashing objects on stage draw attention, something scientists call sensory capture.

Active misdirection. A performer may tell a volunteer to perform an irrelevant action, thereby putting the focus on that activity.

Time misdirection. A delay between the method behind a trick and its effect prevents people from linking the two.

A decoy action with an apparent purpose, such as adjusting a hat, can disguise a related, more surreptitious maneuver. Did the magician slip something under the brim?

Decoy actions. If an action seems to have an obvious purpose, such as scratching an itch or adjusting a hat, an audience generally will not notice that a magician has, say, used the move to put an object under the hat or behind his ear.

attentional tasks but that the degree of the activation was modulated by the amount of effort used to accomplish a task. The harder the task, the more the central region of attention was activated and the more the surrounding region was suppressed.

In a magic show, you face an incredibly difficult task: to peel away all the layers of misdirection and figure out the secret method underlying each magic effect. But the harder you try, the harder it gets: the more your attention is enhanced on the center of the attentional focus, the more your attention is suppressed in all other locations. Of course, the center of the attentional focus is right where the magician wants it—where nothing of particular interest is going on. The locations surrounding your spotlight of attention—where the real action is happening—are now conveniently suppressed by your brain. The armies of neurons that suppress perception in those regions are the magician's confederates.

What Year Is the Coin?

Apollo works his marks as if he knew about these neuronal circuits all along. He'll pull a quarter from your breast pocket and ask, "Is this yours?" You know full well that it's not yours (nobody holds their quarters in their breast pocket). But you can't help it, you inspect George Washington's face as if you might find your initials engraved on his forehead. "What year is the coin?" Apollo asks. And you dutifully try to find out, but the letters are too small and blurry so you reach for your reading glasses … in your breast pocket. They are missing. "Try these glasses," Apollo kindly offers as he hands you the glasses off his face. Your own glasses, as it turns out. While you were busy attending to the quarter, which you should have known didn't actually come from your pocket, Apollo's hands absconded with those glasses literally right under your nose while you suppressed all visual motion surrounding the quarter.

After fleecing George, Apollo turns to the audience and asks, "Now would you like to see the behind the scenes of how I did all that?" Magicians are famously loath to give away their secrets, but Apollo is here in Las Vegas tonight to instruct, not just to entertain.

AARON GOODMAN

➥For a live demonstration of how magicians fool our brains, visit **www.ScientificAmerican.com/Mind/magic**

SPOILER ALERT!
The following section describes magic secrets and their brain mechanisms!

"Frames" are windows of space that the magician creates to localize your attention. A frame can be the size of a whole room or a tabletop or no bigger than a business card. "You have no choice but to watch in the frame," Apollo says. "I use movement, context and timing to create each frame and control the situation." Apollo demonstrates by moving very close to George. He grabs George's hand and pretends to press a coin into it, although all he is really placing there is another sensory afterimage with his thumb. "Squeeze hard," Apollo instructs. George gazes intently at his hand, now caught within a frame. He squeezes. "Do you have the coin?" Apollo teases. George nods. He thinks so. "Open your hand," Apollo says. The palm is empty. "Look on your shoulder," Apollo suggests. George glances to his shoulder where a coin is resting.

Apollo explains that if a subject's attention is localized to a frame, then maneuvers outside the frame will rarely be detected (such as placing a coin on a shoulder). Magicians, he says, thoroughly manage attention at all times. People tend to think of "misdirection" as the art of making someone look to the left while some fast move is pulled on the right, but Apollo says it is more about force-focusing your spotlight of attention to a particular place and at a particular time.

Magicians exploit several psychological and neural principles to focus your spotlight of attention. One is sensory capture, which magicians call passive misdirection. When you see an object that is new, bright, flashy or moving—think of that white dove fluttering out of a top hat—your attention is driven by increased activity from your senses that flows up into your brain. In passive misdirection, you are attending to the fluttering bird while the magician gains a few unattended moments to carry out a sneaky maneuver. It is passive because the magician lets you do all the work. He just sets up the condition.

If more than one movement is visible—the flying dove arches overhead while the magician reaches his hand into a box to set up the next trick—you will naturally follow the larger, more salient movement. You track the bird, not the hand. Hence the magician's axiom, "A big move covers a small move." In fact, a large or fast-moving stimulus, such as the fluttering dove, can literally decrease the perceived salience of a small or more slowly moving stimulus, such as the magician's hand in the box, so that your attention is drawn to the bird, not the hand.

Furthermore, things that are novel (the unexpected dove) produce stronger responses in parts of your brain that are critical to the allocation of attention. The salience of an object is also increased when a magician actively directs your attention to it. For example, Apollo may ask you to leaf through the pages of a book while he places your stolen wallet in his pocket. You become absorbed in the task of turning pages. This is active misdirection. Your top-down attentional control is focused on the book, and you ignore the hand.

Apollo messes with your head in other ways as well. His patter aims to generate an internal dialogue in your mind—a conversation with yourself about what is taking place. This, he says, results in a great deal of confusion. It slows your reaction time and leads you to second-guess yourself. Many magicians can also introduce delays between the method behind a trick and its effect, preventing you from linking the two. They call this "time misdirection." Indeed, in many magic tricks the secret action occurs when you think that the trick has not yet begun or when you think that the trick is over.

END OF SPOILER ALERT

Motion with a Purpose

Another important concept, Apollo tells the scientists gathered in Las Vegas, is that tricks are embedded in natural actions. He dangles a pen in front of the audience with one hand. When he flicks his other hand past his ear, as if to scratch, no one notices. The movement is natural, unremarkable, quick. Suddenly, everyone sees the pen has vanished. Apollo turns his head around to reveal the pen tucked behind his ear.

Teller, the shorter half of the duo Penn & Teller, sheds his mute persona to describe the same concept. "Action is motion with a purpose," he says. In normal social interactions, we constantly search for

JOHN LUND Getty Images

While a magician misdirects an audience to look at a large or fast-moving target, such as a dove fluttering overhead, he can invisibly perform smaller, subtler maneuvers such as sliding a card up his sleeve.

GETTY IMAGES

Apollo messes with your head in other ways as well. His patter aims to generate an internal dialogue in your mind that causes confusion and leads you to second-guess yourself.

the purpose motivating other people's actions. An action with no obvious purpose is anomalous. It draws attention. When the purpose seems crystal clear, however, we look no further. Teller explains that he will draw suspicion if he raises his hand for no apparent reason but not if he performs a seemingly natural or spontaneous action such as adjusting his glasses, scratching his head, pulling a pencil out of his pocket, or draping his coat over the backrest of a chair.

Neuroscientists now have a good idea why such decoy actions are so good at fooling us. Brain cells called mirror neurons help us understand the actions and intentions of other people. They do this by automatically mimicking others' actions and assuming their intentions [see "A Revealing Reflection," by David Dobbs; Scientific American Mind, April/May 2006]. So when you see Teller reach for a glass of water, you do the same thing in your mind. You also ascribe a simple motivation to him, namely, that he is thirsty and will raise the glass to his lips and take a drink. Your brain makes a prediction and runs a simulation, automatically and usually subconsciously.

Mirror neurons are part of how we are able to understand one another, to imitate, to learn and teach, to empathize. But they can also mislead us. A good magician can disguise one action as another or convincingly fake an action he isn't really performing, prompting your mirror neurons to feed you false inferences about what he is actually doing or not doing. You see Teller raise the glass to his lips and seem to drink, and your automatic prediction seems to be fulfilled. But did he really take a drink? Maybe he transferred something from hand to mouth or from mouth to hand. **M**

(Further Reading)

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- **Attention and Awareness in Stage Magic: Turning Tricks into Research.** S. L. Macknik, M. King, J. Randi, A. Robbins, Teller, J. Thompson and S. Martinez-Conde in *Nature Reviews Neuroscience,* Vol. 9, pages 871–879; November 2008.
- **Magic and the Brain.** Susana Martinez-Conde and Stephen L. Macknik in *Scientific American,* Vol. 299, No. 6, pages 72–79; December 2008.
- Apollo Robbins at the Magic of Consciousness Symposium: **http://sleightsofmind.com/media/magicsymposium/Apollo**

When Character Crumbles

A little-known dementia that destroys social sensibilities and emotions reveals the neural roots of personality

By Ingfei Chen

Harriet Holliday sparkled with personality. She reminded Kevin Horowitz, her third husband, of the mother in *Mamma Mia!*—free-spirited, flamboyant and nurturing. She dressed with a sexy, sophisticated glamour and regaled friends with witty tales at soirees. As hospitality manager at a winery in Napa Valley in California, she planned events for hundreds of guests. But around six years ago, at age 49, Holliday "started turning mean," Horowitz recalls. "She didn't know when to hold her tongue."

She became touchy and sarcastic, alienated friends and was soon fired from her job. Other odd or inappropriate behaviors surfaced. When the couple dined out, Holliday would wear a stylish dress with house slippers. She flirted outrageously with young male strangers and tickled them.

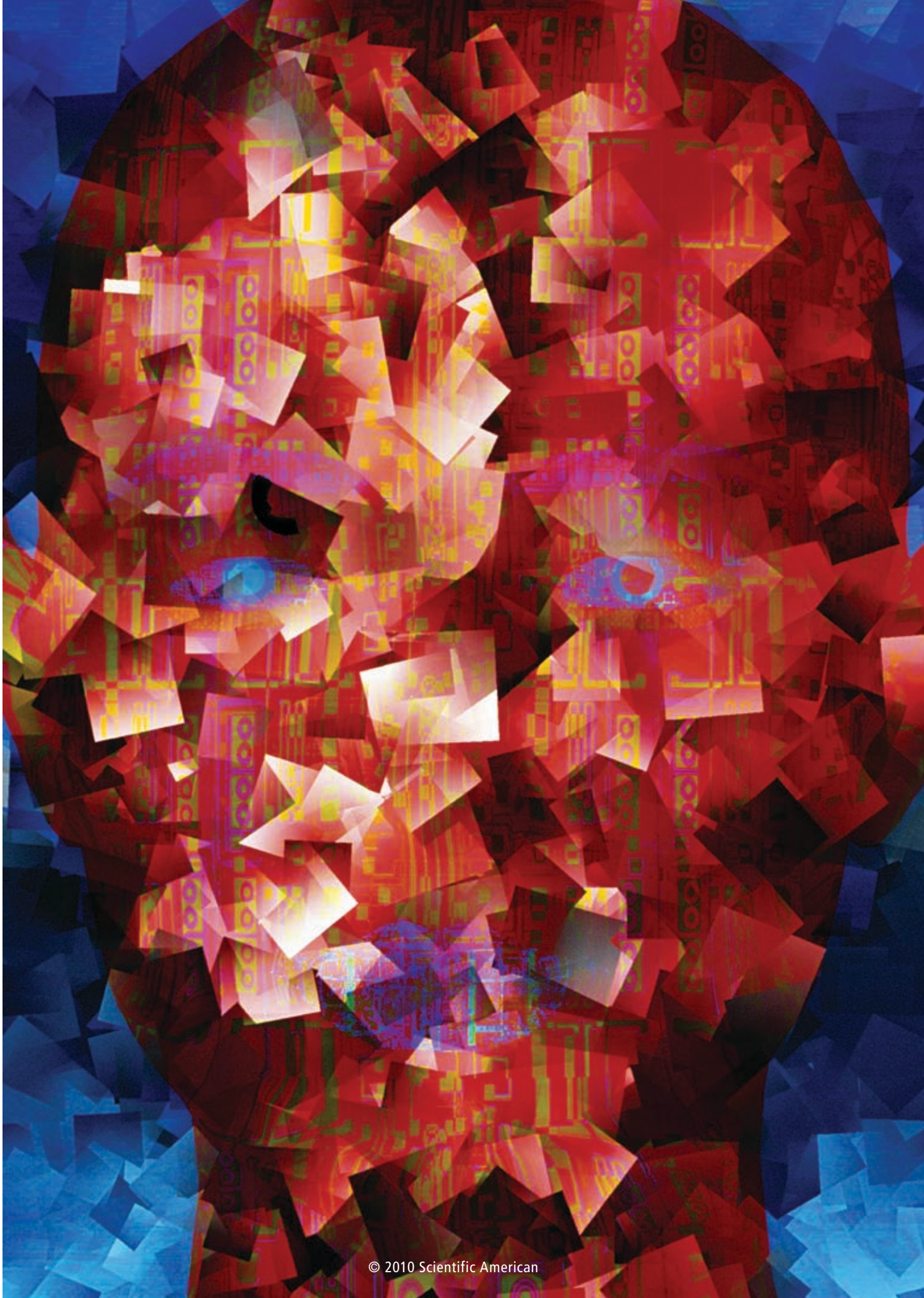
After years spent exploring possible explanations for Holliday's strange transformation, from menopause to depression, the couple learned in 2009 that she had a little-known, incurable and fatal disease: frontotemporal dementia (FTD), in which significant portions of the brain's frontal and temporal (side) regions degenerate.

Most of us think of dementia as a thief of memory and thinking, but this particular variety instead steals away social graces, emotions and empathy. Often the first signs are "changes in the way that people relate to others that make them unlikable," says neurologist Bruce L. Miller, director of the Memory and Aging Center at the University of California, San Francisco, where Holliday's illness was definitively diagnosed.

Frontotemporal dementia is actually the most common form of dementia in people younger than 60, typically striking earlier than Alzheimer's disease and culminating in death within roughly eight years. By one estimate, 15 out of 100,000 people between the ages of 45 and 64 develop it. Patients lose the ability to connect with others, but because self-awareness also disappears, they remain ignorant of their deficits.

By revealing what human behavior and personality look like when stripped of emotional connectedness, the tragic disorder starkly illustrates how profoundly our species is wired to be social. Studying people with this social dementia offers a unique opportunity to understand the neural underpinnings of self-awareness, of certain complex emotions that emerge only in social situations and of basic personality traits. "You can't take a human being and cut part of their brain out and see whether they're still empathic or whether their personality changes," says U.C.S.F. neuropsychologist Katherine P. Rankin. But this illness is nature's equivalent of that experiment.

Studies of patients have, for example, revealed that personality—the pattern of habits and emotional tendencies that distinguishes individuals—does not simply emerge from a soup of brain chemicals but can be traced to specific brain structures and circuits. In particular, personality may reflect how effectively certain brain regions are interconnected. One such net-



HARALD SUND *Getty Images*

Before her illness, Harriet Holliday (shown in 1999, *right*) exuded glamour and joie de vivre, drawing people to her. Beginning six years ago, however, a progressive brain disorder flattened her personality, diminishing her ability to connect with others. Her husband (with her earlier this year, *left*) now tries to manage her often inappropriate behavior.

work that monitors self-awareness and social and emotional cues—and is ravaged in FTD—seems to play a key role in interpersonal warmth and empathy. Eventually researchers might know enough to determine a person's capacity for, say, extroversion or anxiousness from scans that assess the size of relevant brain structures and the strength of their connections with one another.

The "Other Dementia"

First described in 1892 by Czech neurologist Arnold Pick, the classic form of FTD (also called Pick's disease) was tricky to diagnose and largely went overlooked for nearly a century. In the 1980s neurologists in the U.S. believed Alzheimer's disease was the only significant cause of dementia. But in 1987 Swedish neuropathologist Arne Brun and psychiatrist Lars Gustafson autopsied 158 dementia sufferers and discovered that 13 percent of them had Pick's or other types of FTD.

Miller was among a handful of researchers who in the 1990s characterized the peculiar social decline that typically occurs in FTD and established it as a separate entity from Alzheimer's. People with Alzheimer's retain their social skills in the early stages, and many remain warm and sensitive to the end. Initially their illness mainly devastates the back-of-the-brain regions involved in memory, language and visuospatial skills, only later spreading toward frontal areas. FTD often spares those posterior brain areas [*see bottom illustration on opposite page*]; its biggest symptoms are, instead, disinhibition leading to disruptive behavior, a shift toward emotional coldness, and apathy. Patients also often overeat and lose their judgment, sometimes losing control over their finances and going bankrupt.

Miller believes that many cases are still overlooked, because spouses and family—and even many medical professionals—usually view the first changes as signs of a midlife or marital crisis. Of the frontotemporal patients who come to U.C.S.F., roughly half are initially misdiagnosed, most commonly with Alzheimer's, depression, bipolar disorder or, occasionally, schizophrenia.

No treatment exists yet for FTD, although doctors may try to temper behavioral troubles with psychiatric drugs and psychologists can offer supportive guidance. Researchers know that in about half of patients, a protein called tau (also implicated in Alzheimer's) forms in toxic clumps inside neurons in frontotemporal areas. In most other cases, the brain cells are sickened from pileups of a protein called TDP-43, which is also a culprit in amyotrophic lateral sclerosis, or Lou Gehrig's disease.

Ground zero of FTD seems to be an unusually large, spindle-shaped kind of neuron that exists only in the brain's frontal lobes—specifically, in the frontal insula and anterior cingulate cortex. In a 2006 study U.C.S.F. neurologist William W. Seeley and his colleagues analyzed brain tissue from deceased FTD patients and observed that in early stages, the disease selectively decimates these cells, called von Economo neurons (VENs). Brain-scan studies suggest that the frontal insula and anterior cingulate are active when we are hungry, thirsty, in pain or see another person in pain. The insula, in particular, monitors both our own bodily sensations as well as our

FAST FACTS

Thief of Feeling

1» Instead of robbing memory and thought, the most common variety of dementia in people younger than 60 steals away social graces, emotions and empathy.

2» Family members and even doctors may erroneously view early signs of frontotemporal dementia (FTD) as a midlife or marital crisis.

3» Studying people with FTD can help illuminate the neural underpinnings of self-awareness, of certain complex social emotions and of basic personality traits.

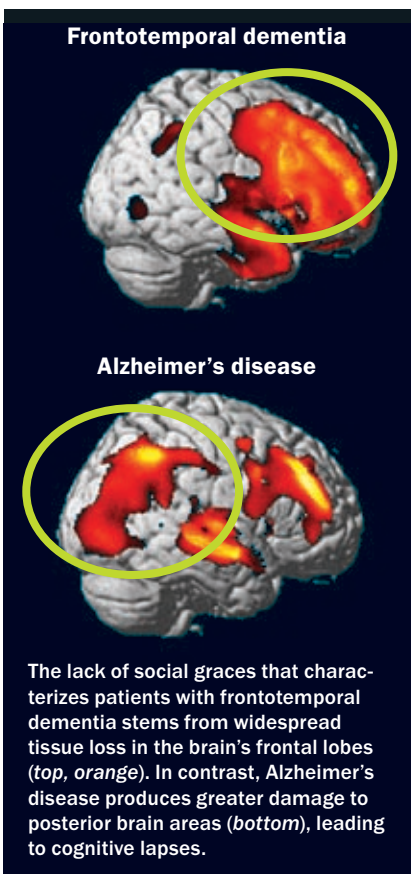
4» Research reveals that personality does not simply emerge from a soup of brain chemicals but can be traced to specific brain structures and circuits.

INGFEI CHEN (*left*); KEVIN HOROWITZ (*right*)

gut feelings about others. Thus, the two regions may be important in sizing up emotionally charged social interactions, and, the researchers speculate, the large size of the VENs may enable them to quickly communicate the gist of those calculations across the brain. When death strikes VENs and the neural network they belong to, "patients lose their social humanity," Seeley says. "It slowly fades away."

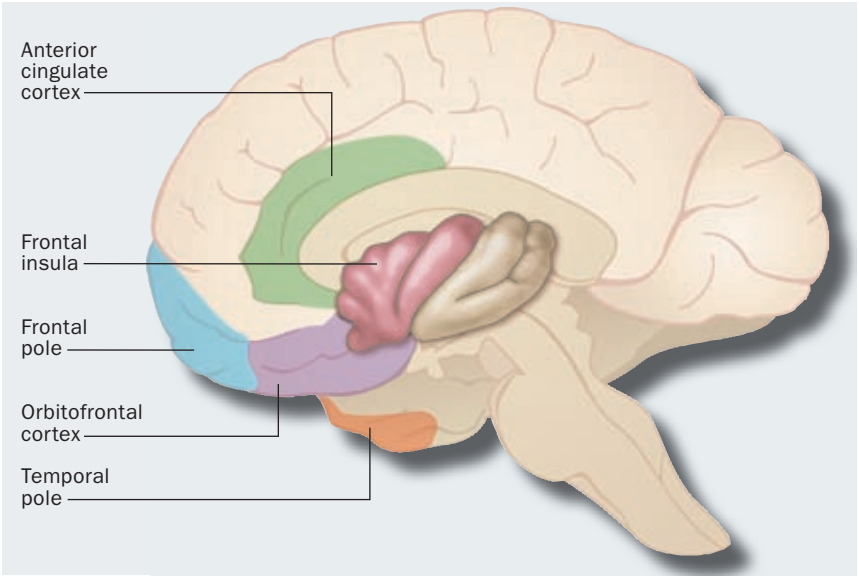
No Inhibitions

In 2008, after learning that Holliday had run up a shocking $74,000 on credit cards, her husband finally realized something was seriously wrong. Although one local physician pronounced an Alzheimer's diagnosis, another specialist suspected FTD and referred her to U.C.S.F. Every year the Memory and Aging Center, one of the world's largest FTD clinics, sees roughly 100 patients with social dementia as part of a multimillion-dollar research program funded by the National Institute on Aging.



The lack of social graces that characterizes patients with frontotemporal dementia stems from widespread tissue loss in the brain's frontal lobes (*top, orange*). In contrast, Alzheimer's disease produces greater damage to posterior brain areas (*bottom*), leading to cognitive lapses.

MELISSA THOMAS (*top*); COURTESY OF HOWARD ROSEN *University of California, San Francisco* (*bottom*)



Frontotemporal dementia, which severely disrupts personality and social skills, wreaks havoc on swaths of the frontal and temporal lobes of the brain, including the anterior cingulate cortex, orbitofrontal cortex, temporal pole and frontal insula.

I met the couple last June when they went to U.C.S.F. for Holliday's second annual assessment—a four-day battery of MRI tests and evaluations by neuropsychologists who probed her cognitive, social and emotional status with verbal questions and pencil-and-paper tests. Now age 55, she was not the angry woman of six years ago: she seemed docile and quiet but removed, with little expressiveness in her face.

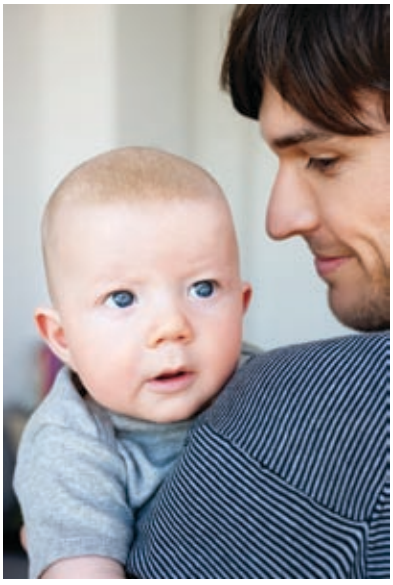
With antidepressant treatment, her cranky behavior had faded into blandness, but she had also grown apathetic. "She doesn't have a lot of the emotions the rest of us have," Horowitz, a man with worried eyes in a sad, worn face, told me. At a funeral they attended, she did not get what the fuss was about. The old Harriet was a fashion maven; now her husband had to lay out her clothing (khakis, button-down shirts) every morning, or she would wear yesterday's outfit. Her impulse control was gone; recently, at the gym, she followed a guy into the men's locker room. Horowitz enrolled her at an adult day care center three days a week. Like a three-year-old, she needed constant supervision.

A few weeks later, in July, Miller convened with half a dozen colleagues to review Holliday's case. On the standard so-called Mini-Mental State Examination of cognitive health, she scored within normal, but results on other tests highlighted some severe deficits in problem solving and other executive functions, cognitive losses that are common in moderate to advanced stages of the disease. And during testing, she was inappropriately goofy and giggly, at one point imitating squirrel noises.

Miller turned to a laptop to scroll through black-and-white MRI images of Holliday's brain. Strikingly, her frontal lobe borders were edged with an en-

The old Harriet was a fashion maven; now her husband had to lay out her clothing or she would wear yesterday's outfit.





Many people with frontotemporal dementia do not recognize basic emotions such as fear, anger and happiness in others, and they particularly have trouble feeling or fathoming complex social emotions such as embarrassment, guilt and pride. Those require self-awareness and the ability to gauge how your own behavior stacks up against social norms—mental processes that such patients lack.

croaching blackness, reflecting tissue loss, instead of being nicely filled out with light-colored areas of healthy wrinkled tissue. Other brain regions toward the back—"Alzheimer's disease central"—were largely intact. "You'd have to be almost an idiot not to be able to diagnose this," he said.

The widespread frontal damage included atrophy in the insula, anterior cingulate cortex and another key target, the orbitofrontal cortex, the area behind and above the eyes that helps in decision making by sensing potential reward or punishment. All three regions normally cooperate with the amygdala to produce complex feelings and social behavior. For instance, structural imaging studies by U.C.S.F. neurologist Howard Rosen correlated orbitofrontal loss with disinhibition and anterior cingulate damage with apathy. Meanwhile, on the right side of Holliday's brain, her anterior temporal lobe, which is important for recognizing emotion and faces, was "paper thin," Miller said.

And yet, Miller said, her behavior was better than that of many patients. One man dropped his pants when he was having his blood drawn. Another, a retired surgeon, broke into his neighbor's house to steal liquor and made sexual advances toward women at a wedding rehearsal dinner. About half of FTD patients had engaged in antisocial behaviors that could (or did) get them arrested, including shoplifting, running a stoplight or driving while drunk.

> "It turns out this is much worse, or it's more hurtful, when someone you love still knows who you are but no longer cares about you."

Short-Circuiting the Self

To tease out the emotional blind spots in social dementia, U.C.S.F. investigators send patients to the laboratory of clinical psychologist Robert W. Levenson at the University of California, Berkeley. Levenson's group monitors how people react during tests designed to elicit specific emotional responses by rigging the subjects with sensors that track heart rate, blood pressure, breathing, sweating and other measures, second by second. Facial expressions and body movements are videotaped and coded for analysis.

One morning in his home office, Levenson played me a video file from Holliday's 2009 emotions assessment. The video showed her hooked up to sensors, staring at a big X displayed on a television screen. Suddenly an explosive bang sounded. She instantly jumped and clutched at her heart, blue eyes wide with fear. Then she just sat there, looking around. Levenson then played clips of healthy test subjects. When the bang went off, one woman let out a loud, shocked gasp, with an exclamation—"God!"—that quickly segued into laughter. This acoustic startle task usually triggers a basic, fearful fight-or-flight reflex, but in the lab, people with intact frontal lobes realize they are being studied, so they also self-consciously chuckle at their reactions. But like Holliday, most social dementia patients show no signs of embarrassment or amusement, Levenson and his colleagues found [*see box on opposite page*].

Although basic emotions such as fear, anger, sadness and happiness still

JOEY BERG *Getty Images (left)*; AGE FOTOSTOCK *(center)*; JUPITERIMAGES *(right)*

function at a low level in FTD, the more complicated social or self-conscious emotions, including embarrassment, guilt and shame, take a big hit. Those feelings require self-awareness and the ability to gauge how your behavior stacks up against social norms—mental processes that FTD patients lack.

In addition to their lack of self-consciousness, patients can also be shockingly callous. When shown scenes from movies, for instance, they typically have trouble recognizing when a character is embarrassed or ashamed and evince little distress when shown images of human suffering. They often display a disheartening loss of compassion in real life, too. One day a woman I will call Alicia briefly blacked out at home while her husband, a retired travel agent who had FTD, was out. Alicia called her son to come over. The husband, a gardener, later drove up with a flat of seedlings. When the son explained that they needed to take Mom to the hospital, his father replied, "I have to first take care of my seedlings," Alicia recalls. "And this is a man that I'm married to, at that point, 44 years," she says with bitterness. He died last May.

From the caregiver's viewpoint, Levenson says, the social dementia has revealed another lesson. Seeing someone lose his or her emotions is even tougher than watching a person's cognition crumble. "It turns out this is much worse, or it's more hurtful, when someone you love still knows who you are but no longer cares about you," he adds. That rejection does not make you sad. "It makes you furious."

Hunting for Personality in the Brain

Although the neuroscience of sentiment is highly complicated, an even bigger conundrum is how the cerebral cortex might blend emotions with behaviors and thoughts to form personality. Only in the past few years have researchers used functional MRI to map out brain circuits for the so-called big five dimensions of personality: openness to new experiences, conscientiousness, extroversion, agreeableness and neuroticism. A few investigations have, for example, traced extroversion to the orbitofrontal cortex.

Though invaluable, fMRI findings from normal brains cannot provide a complete picture for any personality trait or social behavior, Rankin says. For instance, when a dozen neural areas activate during empathy—an emotional response involved in extroversion and agreeableness—that result does not tell you which areas are essential for this feeling, as opposed to just playing a supporting role. On the other hand, Rankin's structural MRI analyses of FTD patients with known brain lesions have shown that real-life empathic abilities are lost when the disease has eaten away specific sections of the temporal lobe—including its forwardmost section, the temporal pole—as well as patches of the orbitofrontal cortex, all on the brain's right side.

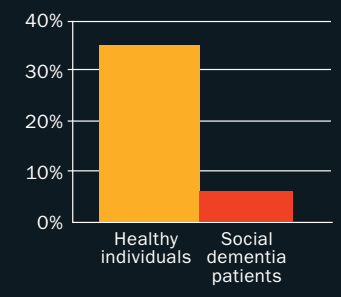
Rankin and other U.C.S.F. investigators have been combining patients' structural brain scans with their psychological evaluations in an attempt to link particular brain regions to personality traits. For instance, in a study published in November 2009 she and neurologist Marc Sollberger asked family caregivers of 214 people with neurodegenerative diseases, including FTD, Alzheimer's and mild cognitive impairment, to rate the patients on 64 adjectives from "shy" to "iron-hearted." Final scores yielded an overall assessment on four pairs of interpersonal traits related to the socially relevant dimensions of extroversion and agreeableness: dominance versus submissiveness, coldness versus warmth, introversion versus extroversion, and arrogance versus ingenuousness.

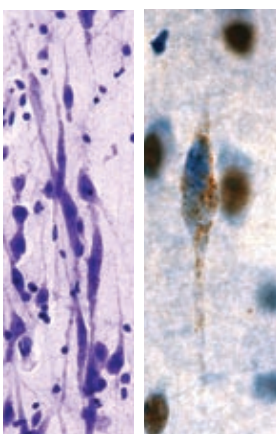
On average, compared with 43 healthy elderly individuals, patients with FTD were less dominant—meaning, less assertive or pushy—and less extroverted, a pattern associated with gray matter loss on MRI scans in certain parts of the frontal lobes, particularly on the brain's left side. Alzheimer's patients showed a similar but smaller shift, a sign of disease having spread to some frontal areas. But only the FTD patients showed decreased warmth, a change associated with atrophy in structures in the right hemisphere, including parts of the temporal lobe, the orbitofrontal cortex, frontal insula and amygdala [*see box on next page*]. "Those structures seem to be necessary to be a warm, connected person," Rankin concludes.

In the simplest terms, social aspects of personality are a balancing act between brain areas that give rise to forceful behavior to get what you want and brain areas that help you understand and

Startling Reactions

A loud bang startles everybody. In the aftermath, more than one third of healthy people (*yellow*) will self-consciously laugh or blush at their reaction, assuming no danger ensues; in contrast, few patients with frontotemporal dementia (*red*) show signs of embarrassment.





Frontotemporal dementia selectively targets so-called von Economo neurons (*left*) that populate key frontal brain regions. In the disorder, a protein (*brown, right*) forms toxic clumps inside these cells.

SOURCE: ROBERT W. LEVENSON *U.C. Berkeley (top)*; FROM "SELECTIVE FUNCTIONAL, REGIONAL, AND NEURONAL VULNERABILITY IN FRONTOTEMPORAL DEMENTIA," BY WILLIAM W. SEELEY, IN *CURRENT OPINION IN NEUROLOGY*, VOL. 21, NO. 6; DECEMBER 2008 *(bottom)*

(The Author)

INGFEI CHEN is a freelance writer in the San Francisco Bay Area. Her articles have appeared in the *New York Times*, *Smithsonian* and *Science*.

Frontotemporal dementia often destroys the ability to feel compassion. When patients with the disorder see someone in trouble, they may not react at all.

care about another person, she says. Holliday, for example, could no longer tell when a voice sounded sad, happy or sarcastic, deficits partly caused by atrophy of the temporal lobe, but she wasn't as cold or introverted as other patients. Meanwhile the extensive devastation of her frontal lobes produced a shift toward submissiveness and a Forrest Gump ingenuousness. On the whole, Rankin's results demonstrate that personality is not merely an epiphenomenon of brain chemistry. Instead interpersonal traits "actually have an anatomy to them," she says.

Given Rankin's research, it is seductive to think, "Gee, maybe that aloof neighbor who never says hello just has a puny right orbitofrontal cortex." Of course, in a healthy person, functioning with a relatively small orbitofrontal area may not be equivalent to having one that has been destroyed by disease. But so far Rankin's findings are fairly consistent with the emerging literature on the neuroscience of normal personality.

Personality Networks

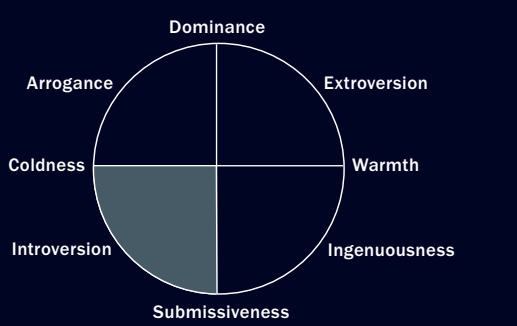
Rankin and others emphasize that personality traits will never be reduced to any single brain structure. Probably more important is how well particular regions interconnect and cooperate. Powerful new insights about brain function in general have been emerging from the discovery of intrinsic connectivity networks (ICNs), neural regions whose activity fluctuates in tight synchrony when the brain is idling or unengaged in any mental task.

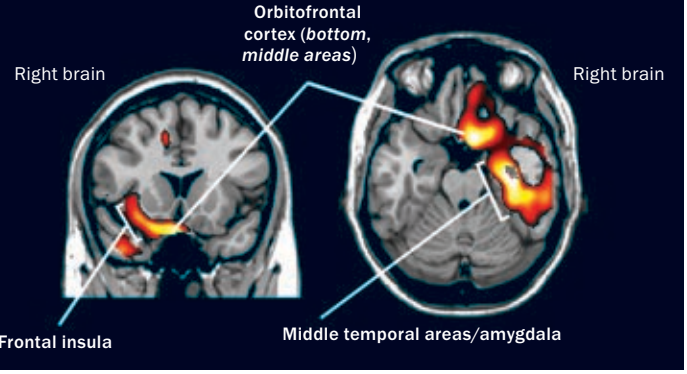
One day brain-scan analyses may grow precise enough to gauge a person's capacity for empathy or to predict aspects of personality.

Some of the same key brain zones that Rankin has linked with warmth toward others, it turns out, are part of an ICN that her colleague Seeley identified and calls the "salience network." It is anchored by the frontal insula and the anterior cingulate cortex [*see box on opposite page*]. Seeley and his collaborators at Stanford University theorize that this network rapidly filters through the

Getting Colder

When scientists assessed people with frontotemporal dementia on four opposing pairs of personality traits, patients displayed less warmth than healthy individuals did, a change linked to tissue death in right-brain structures such as the frontal insula, orbitofrontal cortex and amygdala. Patients also tended to be less assertive and extroverted, moving them into the shaded quadrant of the circle below.





GETTY IMAGES (*top*); FROM "NEURAL BASIS OF INTERPERSONAL TRAITS IN NEURODEGENERATIVE DISEASES," BY MARC SOLLBERGER ET AL., IN *NEUROPSYCHOLOGIA*, VOL. 47: 2009. REPRINTED WITH PERMISSION OF ELSEVIER (*bottom*)

sensory signals, internal bodily sensations, social cues and emotions that deluge the brain every second, then zeroes in on the most pressing problem at hand. It singles out what is important or salient, whether the issue is hunger or a tense social dilemma.

But when this salience network breaks down in individuals with FTD, Seeley says, they cannot pick up social signals or feel the weight of their next actions. Put another way, patients stop caring about loved ones because they "no longer realize that other people are important," Rankin notes. Additional networks most likely play a role in other aspects of warmth and empathy. For instance, Seeley has identified another potential ICN underlying emotional empathy that is anchored by the temporal pole and also disrupted in one type of FTD.

Seeley hopes to refine methods for detecting differences in how "functionally" connected, or synchronized, brain regions within ICNs are in frontotemporal patients; such tools could help diagnose the disorder earlier or track responses to experimental treatments. He and Rankin are also studying whether these functional connectivity levels match up with patients' social behavioral ratings. The researchers think we are headed toward a day when brain-scan analyses of the size and connectivity of particular neural structures will grow precise enough to gauge a person's capacity for empathy or to predict some very basic aspects of personality, such as arrogance or anxiousness. Such technology could have interesting applications.

"You can imagine a dating service that requires people to come down to its office and get in the scanner for 10 minutes" as part of their personality assessment, Seeley says, chuckling. Alternatively, if a brain MRI of a patient receiving counseling revealed a strong response in areas linked with compassion, such a result might greatly inform therapy, Rankin says. On the other hand, weak connectivity in a region important for warmth could point to a different therapeutic target. Some scientists, however, are skeptical that insights into the anatomy of personality will ever be advanced enough to enable such tantalizing uses.

Expanding Devastation

As social dementia progresses from its earliest stages (*left*) to later phases (*right*), scientists see an expansion of dead and damaged tissue (*yellow, orange*) in areas of the frontal lobe. The degeneration seems to start in the anterior cingulate cortex and frontal insula, anchors of a brain network related to warmth toward others.

The Road Ahead

Meanwhile researchers at U.C.S.F. and elsewhere are testing a few treatments for social dementia. In early 2011, for example, investigators at the San Francisco clinic and other centers plan to start a trial with an experimental Alzheimer's drug called Rember in FTD patients. Made by Singapore-based TauRx Pharmaceuticals, the drug is designed to block toxic tau protein buildup inside neurons. Holliday could be eligible for the experimental treatment, but with her substantial brain atrophy, it is unlikely to help much.

The illness has shredded Holliday and Horowitz's plans to retire to Mexico. Horowitz, who owns a construction firm in Napa Valley, now foresees a far bleaker journey. "I'm walking next to her and going all the way down to hell," he told me last summer. And yet, amid this nightmare, he says he is determined "to find something in it that is valuable to someone." That mission explains why they participate in the U.C.S.F. research program. The disintegrating brains of Holliday and others are revealing clues to a cure—and to what makes us human. M

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COURTESY OF WILLIAM W. SEELEY *U.C.S.F.*

Feeling gleeful about the misfortunes of others is a universal emotion that, scientists are discovering, has biological roots.

GETTY IMAGES

Their Pain, Our Gain

You've heard that misery loves company. Enjoying others' misery does, too

By Emily Anthes

There is no English translation for the German word *schadenfreude*—that small, private rush of glee in response to someone else's misfortune. But everyone recognizes the emotion, even if he or she might not have a word for it (or admit to feeling it). Tabloids have long relied on people's fascination with public failures: moralizing politicians or entitled actresses disgraced for their peccadilloes. And in recent years schadenfreude has become a prime-time staple, with models, boyfriends, parents, overweight people and recovering addicts, among others, routinely humiliated on cable television.

Scientists who study schadenfreude are learning that this secret happiness at another person's loss has biological underpinnings. The feeling registers in the brain as a distinct form of pleasure, a satisfaction comparable to that of eating a good meal.

In a study published in 2009 neuroscientist Hidehiko Takahashi of Japan's National Institute of Radiological Sciences and his colleagues asked 19 adult volunteers to read scenarios describing the successes and misfortunes of fictional characters and to report their feelings about these people. Meanwhile Takahashi's team scanned their brain using functional MRI. The researchers found that when the participants reported feeling envy, a brain region known as the anterior cingulate cortex became unusually active. The anterior cingulate plays a role in processing physical pain, suggesting that envy is an unpleasant experience. On the other hand, feeling schadenfreude activated the striatum, a brain region involved in processing rewards. Thinking bad thoughts can feel good.

From an evolutionary standpoint, schadenfreude makes a

FAST FACTS

Feeling Good When Others Feel Bad

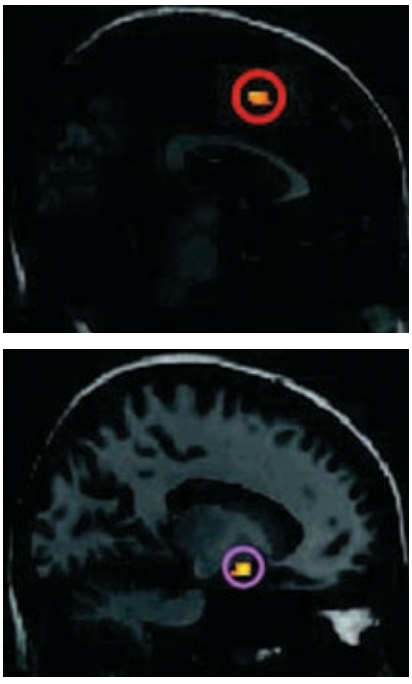
1» **Schadenfreude registers in the brain as a pleasurable experience, a satisfaction comparable with that of eating a good meal.**

2» **During the course of evolution, humans likely developed the instinct to notice, and profit from, the weaknesses of their competitors.**

3» **When groups or even entire nations feel schadenfreude, it can become more potent and insidious, driving deep-seated prejudices that can lead to violence.**

lot of sense. The world is a competitive place, and an individual benefits, for instance, when a sexual competitor breaks a leg or a hunting rival falls ill. "Anytime someone suffers a misfortune, that's an opportunity," says social psychologist Richard H. Smith of the University of Kentucky. "Life is essentially relativistic; [others'] misfortunes are good for the self."

Most of the psychological research has focused on the schadenfreude that people feel toward individuals—such as when a girl who dissed you in high school goes through a nasty, high-profile divorce. But a few investigators are beginning to explore how schadenfreude plays out between rival groups, such as nations, political parties or sports teams. They are finding that such intergroup schadenfreude can be even more potent, and insidious, than individual schadenfreude. It may, in fact, be the first step toward more malicious group interactions, driving deep-seated prejudices that can ultimately lead to violence.



Feelings of envy elicit activity in a brain region called the anterior cingulate cortex (*top*), an arbiter of physical pain. In contrast, schadenfreude activates the striatum (*bottom*), a reward center.

Strength in Numbers

In one study that revealed the exceptional intensity of intergroup schadenfreude, social psychologists Wilco van Dijk of Leiden University in the Netherlands and Jaap Ouwerkerk of the Free University Amsterdam asked individuals—and separately, teams of two people—to play a game in which they were given money and could decide how much to share with others. After several rounds of sharing, the participants were allowed to vote one of their fellow players or teams out of the game for whatever reason. Van Dijk and Ouwerkerk found that the teams shared less money with their competitors than individuals did, and they also reported that the participants felt more joy when rival teams were voted out of the game than when individuals were.

"Schadenfreude is normally triggered by competitiveness," van Dijk says. And social scientists have repeatedly documented that individuals in groups are more competitive than they are by themselves. Researchers are not sure what is responsible for this phenomenon—known as the individual-group discontinuity effect—but one theory holds that group members feed off the emotions of other team members, amplifying their drive to win and desire to eliminate rivals.

Schadenfreude may be particularly susceptible to this group effect, says social psychologist Russell Spears of Cardiff University in Wales. Because it is not a feeling people trumpet with pride, individuals may hide it, dampening its effect. But among members of a team, the emotion becomes acceptable as a way to bond or express group loyalty, and knowing that others share your joy can constitute permission to embrace the feeling. Once in the open, the feeling can grow. "The sharing of an emotion is likely to strengthen it by validating it," Spears says.

In fact, researchers have found that some people may identify so strongly with their groups that they experience schadenfreude in situations that are objectively bad for an entire society, including perhaps themselves. Take, for instance, a recession. Although a recession hurts everyone, Smith and his colleagues hypothesized that some Americans might be quietly pleased to see the economy weaken if they thought the downturn would threaten their rival political party. They tested this scenario in a study published in 2009.

The scientists analyzed undergraduate students' reactions to current events in the run-up to the 2004 and 2008 presidential elections and the 2006 midterm elections. The students completed surveys about their political beliefs and gave their reactions to news stories detailing various national and political misfortunes. The researchers found that Democrats experienced schadenfreude—reporting that they were "secretly happy," for instance—when reading about the economic downturn and the deaths of American troops abroad because they believed these events would bode well for their party. "Whether the event was good or bad in the objective sense was not as important as 'Well, will this help my party or not?'" Smith says. And the more strongly the students identified as Democrats, the more schadenfreude they reported. (The Democrats, Smith noted, were sad that soldiers had died, but unlike the Republicans, many of them thought the cloud of casualties had a silver lining.)

From Bad Karma to Bad Behavior

Schadenfreude is not in itself terribly worrisome. "What becomes dangerous is what schadenfreude turns into," says social

(The Author)

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SOURCE: "WHEN YOUR GAIN IS MY PAIN AND YOUR PAIN IS MY GAIN: NEURAL CORRELATES OF ENVY AND SCHADENFREUDE," BY HIDEHIKO TAKAHASHI ET AL., IN *SCIENCE*, VOL. 323; FEBRUARY 13, 2009

Terrorists and dictators looking for new recruits exploit the human tendency to feel joyful when rivals suffer.

Some psychologists believe that schadenfreude could have helped motivate violent groups such as Rwandan soldiers (*left*), disciples of Hitler (*center*) and militant jihadists (*right*) to wage war on others.

psychologist Colin W. Leach of the University of Connecticut. In a 2009 study he and Spears asked 119 Dutch students to complete a series of surveys, which included questions about how much they disliked various nationalities, including the Germans. The subjects then read articles about a major soccer tournament in which their national team reached the semifinals and the German team—a fierce rival—was eliminated early in the tournament. The students reported how they felt about the German loss and to what degree a list of positive and negative traits such as "persistent," "strong," "arrogant" and "rude" applied to Germans as a whole.

Although a person's overall fondness for or dislike of Germany was not correlated with the amount of schadenfreude he or she felt, the more schadenfreude a student experienced, the more he or she subsequently believed the negative stereotypes of the German populace. The researchers speculated that the students wanted to rationalize the fact that they felt pleasure at another group's misfortune. To do so, Leach says, they might have had to tell themselves, "We're feeling good about people suffering, and we'd only do that to bad people, people who aren't deserving of nicer treatment." In this way, schadenfreude resulting from seemingly benign rivalries could foster real prejudice.

The intergroup emotions Leach and Spears uncovered in their studies were so strong that they speculated in a 2008 book chapter that schadenfreude could play a role in serious group conflicts, including those that led to the Rwandan genocide and the Holocaust. Could schadenfreude explain why many Germans did not come forward to help the Jews during the Holocaust? Even those who would never have perpetrated violence may have felt some satisfaction in seeing the Jews suffer. "There was a lot of resentment built up toward the Jews at that time," Spears says, "so that could have motivated schadenfreude and the absence of intervention" among some Germans.

Schadenfreude could then set the stage for further prejudice. "The more you express this nasty feeling toward a group," Leach says, "the further you're pushing them out of your circle of moral concern and sympathy." By devaluing the lives of members of rival groups, schadenfreude could lead to tacit acceptance of discrimination or even hatred.

Bystanders who find themselves secretly enjoying bearing witness to such persecution may be on the road to becoming perpetrators themselves. "You can imagine a kind of vicious circle," Leach says, in which you "enjoy their suffering so much that maybe if the opportunity arises, you want to cause that suffering." Terrorists, dictators and extremists looking for new recruits may have figured out this relationship, Leach thinks, and they exploit the human tendency to feel happy when rivals suffer. Leaders of violent groups, he says, may be "just really good and intuitive social psychologists."

Schadenfreude is a common emotion, but it is one people rarely talk about. Researchers such as Spears and Leach are hoping to break that silence, believing that we should confer more openly about the private joy we so often feel when other individuals or groups suffer misfortunes. Such a dialogue might help us recognize the feeling more readily and prevent it from escalating. "It's subtle," Leach says of schadenfreude. "But it has this potential to turn into something else—to be a first step on a slippery slope." M

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CHRISTOPHE CALAIS *Corbis (left)*; HULTON-DEUTSCH COLLECTION/CORBIS (*center*); ROBERT NICKELSBERG *Getty Images (right)*

Meeting Your Match

Feelings of rivalry can change our thoughts and behavior

By Ferris Jabr

Even before a game begins, an athlete's body changes: heart rate increases, hormones surge and beads of sweat dapple the skin. Competition is such a visceral experience that the mere anticipation of a challenge excites our instincts to fight. These biological responses are even more pronounced when people face an opponent they have come to know and despise, an opponent they must battle again and again—a rival. In a 2003 study psychologists at Northumbria University in England found much higher testosterone levels in soccer players preparing to play against a team they considered an extreme rival than in those matched up with a moderate rival.

FAST FACTS

Unfriendly Competition

1» Competing against a rival offers a unique psychological prize: the chance to beat someone familiar whose abilities are frustratingly matched with our own.

2» Rivalry can be highly motivating, but it can also impair people's judgment and bias their recall of events.

3» Rivalry can lead to corrupt behavior: thinking about a rival led people to later lie about their performance on an unrelated task.

Rivalry differs from other kinds of competition in its intimacy. It offers contenders a psychological prize people cannot win in other contexts: the chance to beat someone obnoxiously familiar, someone whose abilities and traits are frustratingly matched with their own.

Whether on the field, in a classroom or at work, rivalry changes more than our body chemistry. Researchers are now finding that it also sways our minds, changing how we think and behave during competition—and outside of it. Rivalry not only boosts motivation but also can disrupt rational thinking, bias memories and encourage unethical behavior.

Improving Performance

Although competition has long interested social psychologists, only recently have scientists looked at situations involving true rivals. They are discovering that the psychology of rivalry differs in important ways from that of ordinary competition.

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On the positive side, rivalry can be highly motivating. In unpublished work social psychologist Gavin J. Kilduff of New York University's Stern School of Business analyzed six years' worth of race results archived by a running club in the Northeast to identify rival racers—runners who were evenly matched, similar to one another in age and gender, and who frequently competed against one another. Kilduff found that runners consistently ran faster when competing against rivals. The mere presence of a rival could trim between 20 and 30 seconds off a runner's total race time in a five-kilometer race. Above and beyond ordinary competition, rivalry delivered a measurable boost to motivation and performance. Rivalry changes behavior by endowing competition with a significance that exceeds the objective stakes of the contest, Kilduff believes. "Defeating a rival feels good in and of itself, beyond what else is tangibly at stake," he says.

Creating rivalries could improve athletic performance, Kilduff suggests. In practice scrimmages, for example, instead of mixing up the players each time, coaches could create stable teams to build up a rivalry. Coaches might also repeatedly pit two individuals with similar abilities against each other. "If you can play up the rivalry with someone you are training with, it could certainly improve motivation and performance," Kilduff says.

Bad Decisions

Rivalry can often hamper performance, however, especially when it comes to decision making. In a 2005 study negotia-

The students who faced a rival scored higher on a test of Machiavellian attitudes. High scores correlate with cheating, lying and exploitation.

Rivalry can influence attention and memory, shifting the brain's focus from avoiding a loss to seeking a win. As a consequence, sports fans remember outcomes that favor their team more accurately than they recall those that benefit a rival.

tions expert Deepak Malhotra of Harvard Business School and his colleagues asked participants to imagine themselves at an auction for a one-of-a-kind item for which they agreed to pay no more than $150. In the final round of bidding, some of the participants were told there were eight other contenders for the item, whereas others were told they were up against only one, to simulate a type of rivalry. Then the researchers told all participants that a competitor had bid $150 and that they had to decide whether to bid higher. Participants facing a single bidder rated their excitement and anxiety as much higher than those bidding against a group and were far more likely to exceed the preset bidding limit. This behavior is economically irrational, because the more bidders remaining in an auction's final round, the more the contested object is likely to be worth.

"People seem to start out with reasonable goals," Malhotra says. "But in the heat of the moment their motivation shifts, and they want to win at any cost." Similar feelings of rivalry can overpower rational thinking during an argument with a close friend or family member, making what might have been a productive debate into a useless verbal sparring match that, of course, neither party can really win. On a larger scale, corporate rivals may engage in egregiously expensive marketing campaigns to outdo one another or to tarnish a competitor's reputation, Malhotra says.

Rivalry impairs not only judgment but also people's actual memories. In a study published in February, psychologist Kevin S. LaBar of Duke University invited male fans of the Duke men's basketball team and male fans of Duke's rival, University of North Carolina at Chapel Hill, to watch their teams face each other on a big screen TV. Each participant watched the game with two or three other fans of the same team. Later, LaBar asked the fans to view segments of the game while lying in a functional MRI machine. Each segment focused on a single play whose outcome clearly benefited either Duke or U.N.C.—but the clip always ended just before the play did, at which point the fan tried to recall how the play ended.

LaBar found that fans remembered outcomes that favored their team far more accurately than those benefiting the rival team. Accordingly, brain regions implicated in emotion, attention and memory responded more vigorously to plays that fans interpreted as helping, as opposed to hurting, their team. Usually negative stimuli elicit the most intense emotional responses, leading to the strongest memories. But rivalry seems to shift the brain's focus to the rewards of winning, making triumph more memorable.

Success at Any Cost

Rivalries not only bias our thought processes but also can corrupt our moral code. We have all witnessed rivals trading put-downs and playing practical jokes on each other. But more surprisingly, the unsavory behavior spawned from rivalry can spill over into other, totally unrelated domains. In another study, also as yet unpublished, Kilduff and his colleagues—social psychologists Niro Sivanathan of the London Business School and Adam Galinsky of Northwestern University—asked people to recall a personal encounter with a rival, a recent ordinary competition or a recent collaborative effort from

(The Author)

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Rivalry can impair decision making. When auction-goers are pitted against one bidder as opposed to several, they are more likely to exceed their spending limit.

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their everyday experiences. Participants then completed a series of puzzles and scored their own success. Students who recalled competing against a rival were more likely to deliberately exaggerate their performance. In other words, remembering a rival motivated them to lie about their performance on a subsequent unrelated task. Kilduff suspects that conjuring up memories about rivalry leaves a psychological residue that taints other choices we make. It makes us want to succeed at any cost and more likely to deceive and cheat.

Because we encounter people we consider rivals quite often—both in and outside of direct competition—rivalries may alter our motivation and moral code on a regular basis, Kilduff believes. Logging onto Facebook in the morning and scrolling through your news feed only to stumble on a personal rival's obnoxious status update or vain photos could influence your behavior and decisions throughout the day. You might be more likely to, say, run that red light, cut in line at the movie theater, claim a co-worker's idea as your own or tell a white lie to excuse a transgression against someone you love.

In related work, also unpublished, Kilduff tested the relation between rivalry and unethical behavior by simulating rivalries in the laboratory. He set up two contests. In the rival condition, students repeatedly faced the same opponent and experienced narrow margins of victory and defeat; in the ordinary competition situation, participants faced different opponents and experienced more lopsided margins. The students who faced a rival later scored higher on a test of Machiavellian attitudes, which measures whether people endorse selfish, devious and manipulative behavior. High scores on this scale are correlated with unethical actions such as cheating, lying and exploitation. Competing against a rival, Kilduff says, may bring out the inner Machiavelli in people. "Rivalry opens up the possibility you might behave irrationally or unethically based solely on the relationship you have with your competitor," Kilduff says. "It just changes everything." M

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What Makes a Good Parent?

A scientific analysis ranks the 10 most effective child-rearing practices. Surprisingly, some don't even involve the kids

By Robert Epstein

Amazon.com lists an astounding number of dieting books—more than 16,000. But parenting guides far exceed that number: there are some *40,000* of them, including books such as Jane Rankin's *Parenting Experts,* that do nothing but evaluate the often conflicting advice the experts offer. People, it seems, are even more nervous about their parenting than they are about their waistlines.

Why is there such chaos and doubt when it comes to parenting? Why, in fact, do most parents continue to parent pretty much the way their own parents did—or, if they disliked the way they were raised, the exact *opposite* way? Shouldn't we all just find out what the studies say and parent accordingly?

A growing body of research conducted over the past 50 years shows fairly clearly that some parenting practices produce better outcomes than others—that is, better relationships between parent and child and happier, healthier, better functioning children. And just as we use medical science cautiously and strategically to make everyday health decisions, we can also make wise use of research to become better parents.

A new study I conducted with Shannon L. Fox, a student at the University of California, San Diego, which we presented at the annual meeting of the American Psychological Association this past August, compared the effectiveness of 10 kinds of parenting practices that have gotten the thumbs-up in various scientific studies. It also showed how parenting experts rate those practices and looked at just how many parents actually use those practices. In other words, we compared three things: what experts advise, what really seems to work and what parents actually do.

Our study confirmed some widely held beliefs about parenting—for example, that showing your kids that you love them is essential—and it also yielded some surprises, especially regarding the importance of a parent's ability to manage stress in his or her own life.

Ten Important Competencies

To figure out which parenting skills were most important, we looked at data from about 2,000 parents who recently took an online test of parenting skills I developed several years ago (accessible at http://MyParentingSkills.com) and who also answered questions about their children. Parents did not know this when they took the test, but the skills were organized into 10 categories, all of which derive from published studies that show that such skills are associated with good outcomes with children. The 10 skill areas measured by the test were also evaluated by 11 parenting experts unknown to Fox and me, and we in turn were unknown to them (in other words, using a double-blind evaluation procedure).

On the test, parents indicated for 100 items how much they agreed with statements such as "I generally encourage my child to make his or her own choices," "I try to involve my child in healthful outdoor activities" and "No matter how busy I am, I try to spend quality time with my child." Test takers clicked their level of agreement on a five-point scale from "agree" to

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"disagree." Because all the items were derived from published studies, the answers allowed us to compute an overall skill level for each test taker, as well as separate skill levels in each of the 10 competency areas. Agreement with statements that described sound parenting practices (again, according to those studies) yielded higher scores.

The 10 kinds of parenting competencies, which we call "The Parents' Ten," include obvious ones such as managing problem behavior and expressing love and affection, as well as practices that affect children indirectly, such as maintaining a good relationship with one's co-parent and having practical life skills [*see box on opposite page for a complete list*].

In addition to asking test takers basic demographic questions about their age, education, marital status, parenting experience, and so on, we also asked them questions about the outcomes of their parenting, such as "How happy have your children been (on average)?," "How successful have your children been in school or work settings (on average)?" and "How good has your relationship been with your children (on average)?" For questions such as these, test takers clicked on a 10-point scale from low to high.

With scores in hand for each parent on all "The Parents' Ten," along with their general assessments regarding the outcomes of their parenting, we could now use a statistical technique called regression analysis to determine which competencies best predict good parenting outcomes. For an outcome such as the child's happiness, this kind of analysis allows us to say which parenting skills are associated with the most happiness in children.

FAST FACTS

Essential Parenting Skills

1» Decades of research reveal 10 essential parenting skill sets. A new study of 2,000 parents determined which skills are most important to bringing up healthy, happy and successful kids.

2» Giving love and affection tops the list. Then comes a surprise: managing stress and having a good relationship with the other parent are more helpful than some child-focused behaviors.

3» All types of people are equally competent at child-rearing—and anyone can learn how to be a better parent with a little effort.

Love, Autonomy and Surprises

Our most important finding confirmed what most parents already believe, namely, that the best thing we can do for our children is to give them lots of love and affection. Our experts agreed, and our data showed that this skill set is an excellent predictor of good outcomes with children: of the quality of the relationship we have with our children, of their happiness, and even of their health. What's more, parents are better at this skill than they are at any of the others. We also confirmed what many other studies have shown: that encouraging children to become independent and autonomous helps them to function at a high level.

Parents' **ability to manage stress** was a good predictor of the quality of their relationship with their children.

But our study also yielded a number of surprises. The most surprising finding was that two of the best predictors of good outcomes with children are in fact *indirect:* maintaining a good relationship with the other parent and managing your own stress level. In other words, your children benefit not just from how you treat *them* but also from how you treat your partner and yourself.

Getting along with the other parent is necessary because children inherently want their parents to get along. Many years ago, when my first marriage was failing, my six-year-old son once led me by the hand into the kitchen where his mom was standing and tried to tape our hands together. It was a desperate act that conveyed the message: "Please love each other. Please get along." Children do not like conflict, especially when it involves the two people in the world they love most. Even in co-parenting situations where parents live apart, it is crucial to adhere to practices that do not hurt children: to resolve conflicts out of sight of the children, to apologize to one another and forgive each other (both can be done in front of the kids), to speak kindly about the other parent, and so on.

Stress management is also important for good parenting, just as it is vital in all aspects of life. In our study, parents' ability to manage stress was a good predictor of the quality of their relationship with their kids and also of how happy their children were. Perhaps more telling, people who rated themselves as great parents scored more highly on stress management than on any of the other nine parenting competencies. There is, possibly, a simple lesson here: parents who lose their temper around their kids know that that is bad parenting. Keeping calm is probably step one in good parenting. Fortunately, stress management practices such as meditation, imagery techniques and breathing exercises can be learned, no matter what one's natural tendencies. People can also learn better organizational skills and even ways of managing stressful thinking.

Keeping children safe—a matter of almost obsessive concern among American parents these days—seems to have both

The Parents' Ten

Here are 10 competencies that predict good parenting outcomes, listed roughly in order from most to least important. The skills—all derived from published studies—were ranked based on how well they predict a strong parent-child bond and children's happiness, health and success.

1. **Love and affection.** You support and accept the child, are physically affectionate, and spend quality one-on-one time together.
2. **Stress management.** You take steps to reduce stress for yourself and your child, practice relaxation techniques and promote positive interpretations of events.
3. **Relationship skills.** You maintain a healthy relationship with your spouse, significant other or co-parent and model effective relationship skills with other people.
4. **Autonomy and independence.** You treat your child with respect and encourage him or her to become self-sufficient and self-reliant.
5. **Education and learning.** You promote and model learning and provide educational opportunities for your child.
6. **Life skills.** You provide for your child, have a steady income and plan for the future.
7. **Behavior management.** You make extensive use of positive reinforcement and punish only when other methods of managing behavior have failed.
8. **Health.** You model a healthy lifestyle and good habits, such as regular exercise and proper nutrition, for your child.
9. **Religion.** You support spiritual or religious development and participate in spiritual or religious activities.
10. **Safety.** You take precautions to protect your child and maintain awareness of the child's activities and friends. —*R.E.*

positive and negative outcomes. On the bright side, in our new study safety skills did contribute to good health outcomes. But being overly concerned with safety appears to produce poorer relationships with children and also appears to make children less happy. A recent study by Barbara Morrongiello and her colleagues at the University of Guelph in Ontario shows how complex the safety issue can be. In their study, young people between the ages of seven and 12 said that even though they were generally conforming to the safety rules of their parents, they planned to behave like their parents when they grew up, even where their parents were, by their own standards, behaving unsafely. Had they detected their parents' hypocrisy?

Another surprise involves the use of behavior management techniques. Although my own training in psychology (under the pioneering behavioral psychologist B. F. Skinner) suggests that sound behavior management—providing lots of reinforcement for good behavior, for example—is essential for good parenting, our new study casts doubt on this idea. Behavior management ranked low across the board: it was a poor predictor of good outcomes with children; parents scored relatively poorly in this skill area; and our experts ranked it ninth in our list of 10 competencies.

In general, we found that parents are far better at educating their children and keeping them safe than they are at managing stress or maintaining a good relationship with the other parent, even though the latter practices appear to have more influence on children. Getting along with one's co-parent is the third most important practice, but it ranked eighth on the parents' list of actual abilities. Even more discouraging, stress management (number two in importance) ranked 10th.

Who Make Good Parents?

Setting aside "The Parents' Ten" for the moment, our study also shed some interesting light on what characteristics a good parent has.

(The Author)

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Ewww ... gross! Maintaining a healthy relationship with your co-parent (spouse or otherwise) is one of the most important child-rearing practices. It's good for kids to see respect, forgiveness and, yes, even love and affection.

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A general parenting ability appears to exist—something like the "g" factor that exists for intelligence. The g factor for parenting emerged very strongly in our study using a statistical technique called factor analysis, which organizes large amounts of test data by clustering test items into a small number of highly predictive variables. Some people just seem to have a knack for parenting, which cannot be easily described in terms of specific skills.

We also found that a number of characteristics that people often associate with good parenting are probably not very significant. For example, women appear to be only a hair better than men at parenting these days—a huge change in our culture. Women scored 79.7 percent on our test, compared with 78.5 percent for men—a difference that was only marginally significant. Parents who were older or who had more children also did not produce significantly better parenting outcomes in our study. Parents seem to perform just as well whether or not they have ever been married, and divorced parents appear to be every bit as competent as those who are still married, although their children are somewhat less happy than the children of parents who were never divorced.

Neither race nor ethnicity seems to contribute much to parenting competence, and gays and straights are just about equal in parenting ability. In fact, gays actually outscored straights by about 1 percentage point in our test, but the difference was not statistically significant.

One characteristic that does seem to make a difference is education: generally speaking, the more the education, the better the parenting. This might be because better educated people also work harder to improve their parenting skills through parent education programs (confirmed by our data). It is also possible that good parents—those with a high parenting g—are also generally competent people who are better educated. In other words, the g for parenting might be the same as the g for intelligence, a matter to be explored in future research.

The bottom line on such findings is that if you really want to know about an individual's competence as a parent, you should measure that competence directly rather than default to commonly held stereotypes. In the U.S., after all, women did not get the vote until 1920 because of faulty assumptions about female limitations. I believe this is one of the main lessons of our study: there is simply no substitute for the direct measure of competence.

Perhaps the best news is that parents are trainable. Our data confirm that parents who have taken parenting classes produce better outcomes with their children than parents who lack such training

People who have taken **parenting classes** produce happier, healthier and more successful children.

and that more training leads to better outcomes. Training programs, such as the evidence-based Parenting Wisely program developed by Donald A. Gordon of Ohio University, can indeed improve parenting practices. Programs are available in major cities around the country, sometimes sponsored by local therapists or state or county agencies. The National Effective Parenting Initiative, which I have been associated with since its inception in 2007, is working to make quality parent training more widely available (see http://EffectiveParentingUSA.org for additional information).

Parents who focus too much on keeping their children safe may see their efforts backfire, winding up with unhappy kids or a poor parent-child relationship. Kids fare better when parents encourage autonomy.

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Where Experts Fail

Although parenting experts do indeed offer conflicting advice at times (perhaps because they don't keep up with the studies!), our experts generally did a good job of identifying competencies that predict positive outcomes with children. There were two notable exceptions: First, they ranked stress management eighth in our list of 10 competencies, even though it appears to be one of the most important competencies. Second, our experts seemed to be biased against the religion and spirituality competency. They ranked it rock bottom in the list of 10, and several even volunteered negative comments about this competency area, even though studies suggest that religious or spiritual training is good for children.

Historically, clinicians and behavioral scientists have shied away from religious issues, at least in their professional lives; that could explain the discomfort our experts expressed about religious or spiritual training for children. Why they were so far off on stress management is truly a mystery, however, given psychology's long interest in both the study and treatment of stress. I can only speculate that stress management is not widely taught in graduate programs in psychology-related fields as an essential component of good parenting. It should be.

Bringing It Home

Tempering one's parenting with relevant scientific knowledge can truly have great benefits for one's family. It can reduce or eliminate conflict with one's children, for one thing, and that in turn can improve a marriage or co-parenting relationship. It can also help produce happier, more capable children.

I have seen how this works in my own parenting. I am a much better parent with my younger children (who range in age from four to 12) than I was with my older two (now 29 and 31). The more I have learned about parenting over the years, the more loving and skillful I have become, with obvious benefits. These days I really do hug my children and tell them I love them several times a day, every day, without exception. When love is never in question, children are much more understanding and tolerant when a parent needs to set limits, which I do regularly. I have also learned to stay calm—to improve the way I react to things. When I am calm, my children are, too, and we avoid that deadly cycle of emotional escalation that can ruin relationships.

Most important, I am much more a facilitator now than a controller. While building my own competence as a parent, I have also put more effort into recognizing and strengthening the competence of my children, helping them to become strong and independent in many ways. My 12-year-old son is now a calm, helpful role model to his three younger siblings, and before I get out of bed these days, my 10-year-old daughter has sometimes already made scrambled eggs for all of them—and cleaned up, too. M

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Getting to Know Me

Psychodynamic therapy has been caricatured as navel-gazing, but studies show powerful benefits

By Jonathan Shedler

Jeffrey (not his real name) came to treatment complaining of depression, anxiety and trouble getting along with others. Colleagues in the engineering department where he worked complained he was "not a team player," and his wife saw him as distant and hypercritical. Beyond this, he carried with him a constant feeling of dread, no matter how well things were going. I agreed with Jeffrey that his dread seemed out of proportion to anything that was actually happening in his life and suggested it might be in proportion to something that was not immediately obvious to either of us. I asked him to tell me about himself. Among other things, I learned that his father had been an alcoholic who would attack without warning, driving Jeffrey to leave home at an early age.

It was one thing for Jeffrey to tell me of his unhappy past, but soon this old relationship pattern came to life, as Jeffrey began responding to me as if I were an unpredictable, angry adversary. Consciously, he saw me as an ally with his welfare at heart. Yet he seemed constantly poised to "protect" himself by fending me off, as though he expected I would use what he said against him. His responses were so ingrained that he did not recognize them as out of the ordinary.

I did not regard Jeffrey's attitude as an obstacle. On the contrary, reliving this relationship pattern with me was central to his recovery. I would frequently point out that Jeffrey was responding as if I were an enemy, and he gradually began to notice, too. In those moments, his thoughts and feelings often ran to his father. I helped him connect the dots: "When you turned to your father for help, he humiliated you. Perhaps a part of you expects the same treatment from me." Jeffrey began to connect with old emotions, speaking of the terror he had felt during his father's outbursts. His sense of dread began to make sense—and then slowly dissipated. Jeffrey gradually recognized—not just intellectually but in a way that truly sank in emotionally—that the beatings were over. The world began to feel less dangerous, and he started letting others "in" in ways he never had before. His work relationships improved, and he and his wife became closer than either had previously thought possible. He began to enjoy his life.

The treatment that helped Jeffrey, known as psychoanalytic or psychodynamic therapy, traces its heritage to psychoanalysis in the famous drapery-hung study of Sigmund Freud in Vienna. But psychodynamic therapy as practiced today bears little resemblance to the world of Oedipal conflict, penis envy and castration anxiety that has been so lampooned in *New Yorker* cartoons and Woody Allen films. Patients do not lie on a couch free-associating as an inscrutable therapist silently looks on,

The term "psychoanalysis" conjures images of Freud's couch (*top left*), but contemporary psychodynamic therapy (*top right*) is not the psychoanalysis of yesteryear. It has evolved new methods and may be the best way to tackle recurring problems.

nor must they commit to four or five sessions a week for years on end.

Freud's legacy is not a specific theory but rather a sensibility: an appreciation of the depth and complexity of mental life and a recognition that we do not fully know ourselves. It is also an acknowledgment that what we do not know is nonetheless manifested in our relationships and can cause suffering—or, in a therapy relationship, can be examined and potentially reworked.

But the modernization of psychodynamic therapy has gone largely unnoticed. For years psychoanalysts did little to disseminate ideas outside their own circles, and this self-imposed exile from academic research left a void, into which was born an alternative: cognitive-behavior therapy (CBT). In this newer approach, therapists focused on specific problems and readily observable thoughts and behaviors, rather than embracing the messy, emotional complexity of people's mental lives.

FAST FACTS

The Value of Self-Examination

1» **Psychodynamic therapy is not the psychoanalysis of Freud's day: patients sit on a chair instead of lying on a couch, have sessions once or twice—not four or five times—a week, and may finish in months as opposed to years.**

2» **Though often dismissed as too open-ended to solve specific problems, psychodynamic therapy alleviates symptoms as effectively as newer, more targeted therapies.**

3» **People who undergo psychodynamic therapy continue to make gains after the therapy ends, perhaps because it addresses underlying psychological patterns that affect many areas of life.**

Over the past decades psychologists have conducted thousands of studies that showed the effectiveness of cognitive-behavior therapy. The approach initially seemed to promise quick cures—a promise that dovetailed with the interests of health insurers, who wanted to pay as little as possible for mental health care. CBT was portrayed as the gold standard, and many practitioners wrote off psychodynamic therapy as antiquated and unscientific. But as I recently showed in a research review published in *American Psychologist*, the prestigious flagship journal of the American Psychological Association, psychodynamic therapy has been not only misunderstood but vastly underestimated.

The reality is that psychodynamic therapy has proved its effectiveness in rigorous controlled studies. Not only that, but research shows that people who receive psychodynamic therapy actually continue to improve after therapy ends—presumably because the understanding they gain is global, not targeted to encapsulated, one-time problems. Thanks to misinformation and entrenched interests, however, much of this research has been overlooked.

Enhancing Self-Awareness

There is no end of cartoons spoofing psychoanalysis: Santa Claus on the couch confessing, "I don't believe in myself anymore," or a house on a couch telling the dispassionate analyst, "My bubble burst!" But cartoons are not reality. Psychodynamic therapy is practical, and it helps free people from suffering. So what is it that makes psychodynamic therapy so powerful? By analyzing tapes from hundreds of hours of actual therapy sessions, researchers have identified seven distinctive features.

Exploring emotions. Psychodynamic therapists encourage patients to explore their full emotional range—including contradictory feelings, feelings that

PETER APRAHAMIAN *Corbis (left)*; JON BRADLEY *Getty Images (right)*

I kept encountering patients who had been shunted from one **"quick fix" treatment** to another, with little lasting benefit.

are troubling or threatening, and feelings they may initially be unable to express. A CBT practitioner might respond to emotional difficulty with homework assignments and worksheets or seek to persuade patients that irrational thinking has skewed their feelings. Psychodynamic therapists, in contrast, are likely to invite patients to explore their feelings further.

Examining avoidances. Efforts to avoid distressing or threatening thoughts and feelings can be obvious, as when patients miss sessions or fall silent. They can also be subtle, as when people focus on facts and events to the exclusion of emotions or emphasize external circumstances instead of their own role in shaping events. Psychodynamic therapists encourage patients to examine why and how they avoid what is distressing.

Identifying recurring patterns. Sometimes people are acutely aware of painful or self-defeating patterns—like choosing romantic partners who are unavailable or sabotaging themselves when success is at hand—but feel unable to escape them. Sometimes they need help to recognize the patterns.

Discussing past experience. Related to identifying recurring patterns is the recognition that past experiences affect our experience of the present. By exploring how early experiences color present-day perceptions, psychodynamic therapists help patients free themselves from the bonds of the past and live more fully in the present.

Focusing on relationships. Psychodynamic therapists recognize that mental health problems tend to be rooted in problematic relationship patterns. For example, some people do not express their emotional needs for fear of rejection and consequently cannot get them met—a recipe for depression vulnerability.

Examining the patient/therapist relationship. In other therapies, patients' emotional reactions to the therapist may be seen as distractions. In psychodynamic therapy, they are the heart of the work. This is because a person's habitual way of being in relationships inevitably emerges in the therapy relationship as well—psychodynamic therapists call this phenomenon "transference." For example, a person who has trouble with intimacy may struggle to open up to the therapist, and one who fears rejection may strive to be an especially "good" patient. Recognizing transference offers patients a unique opportunity to rework old patterns.

Valuing fantasy life. In contrast to CBT, in which therapists may follow a predetermined agenda, psychodynamic therapists encourage patients to speak freely about whatever is on their minds. Fantasies, dreams and daydreams provide a rich source of information about their hopes, desires and fears.

All successful therapies must relieve symptoms such as anxiety or depression. But psychodynamic treatment aims for more: it focuses on building core psychological strengths—such as the capacity to have more fulfilling relationships, to make more effective use of one's abilities, and to face life's challenges with greater freedom and flexibility.

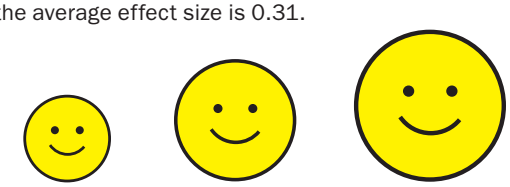
Scientific Evidence

I delved into the research supporting psychodynamic therapy because I kept encountering patients who had been shunted from one "quick fix" treatment to another, with little or no lasting benefit. In my experience, the brief therapies promoted as "empirically supported" were often failing, despite claims that their benefits are scientifically proven.

Cognitive-behavior therapists may also incorporate some of the seven features described above, but not to the same extent as psychodynamic therapists. Instead of encouraging patients to speak freely, they may teach exercises or skills. Instead of exploring feelings in depth, they are more likely to focus on thoughts. Instead of examining how past

Different Ways to Feel Better

Psychodynamic therapy may be more effective than other treatments promoted as "evidence based." One major study found an "effect size"—a measure of treatment benefit—of 0.97. For CBT, 0.68 is a typical effect size. For antidepressant medication, the average effect size is 0.31.



(The Author)

JONATHAN SHEDLER is an associate professor of psychiatry at the University of Colorado School of Medicine and director of psychology at the University of Colorado Hospital Outpatient Psychiatry Service.

and present are interrelated, they are more likely to focus on current events. These approaches often do not address root problems, so patients may feel better temporarily, then continue replaying patterns that cause suffering.

When I was preparing my *American Psychologist* paper, I was amazed by how strong the scientific evidence was in support of psychodynamic therapy. One of the most rigorous studies I described in my paper was led by psychologist Allan Abbass of Dalhousie University in Nova Scotia and published in 2006 in the prestigious *Cochrane Library*. Abbass examined the effectiveness of psychodynamic treatments that lasted for fewer than 40 sessions. His team compiled the results of 23 randomized controlled trials—the kind of carefully orchestrated, rigorous study that medical researchers use to test new drugs. These trials involved 1,431 patients who suffered from depression, anxiety, stress-related physical ailments and other psychological problems.

This kind of investigation is called a meta-analysis because it compiles the findings of numerous other studies. Abbass's meta-analysis found an "effect size" of 0.97 for overall psychiatric improvement. What does that mean? Effect size measures the amount of treatment benefit. In this type of study, an effect size of 0.2 is considered small, 0.5 moderate and 0.8 large, so the benefit Abbass found is huge. Seven other meta-analyses, collectively including 160 studies and a wide range of mental health conditions, also showed substantial benefits for psychodynamic therapy. These studies included both randomized controlled trials—in which groups of patients who receive treatment are compared with groups who do not—as well as studies that evaluated the same patients before and after treatment.

In contrast, a recent (and fairly representative) meta-analysis of 33 rigorously conducted studies of cognitive-behavior therapy for depression and anxiety showed an effect size of 0.68.

Even more intriguing, Abbass's meta-analysis also looked at patient assessments conducted nine months or more after therapy ended. The effect size grew from 0.97 to 1.51. Now, this is astonishing. In fact, six separate meta-analyses reported data from follow-up assessments, and all showed benefits that kept growing after treatment ended. This continued improvement suggests that psychodynamic therapy sets in motion psychological processes that lead to ongoing change.

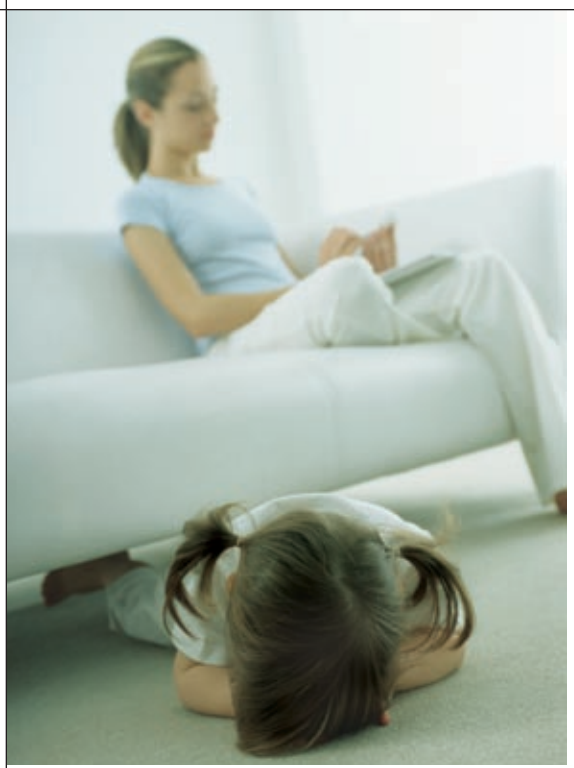
Secret Ingredients

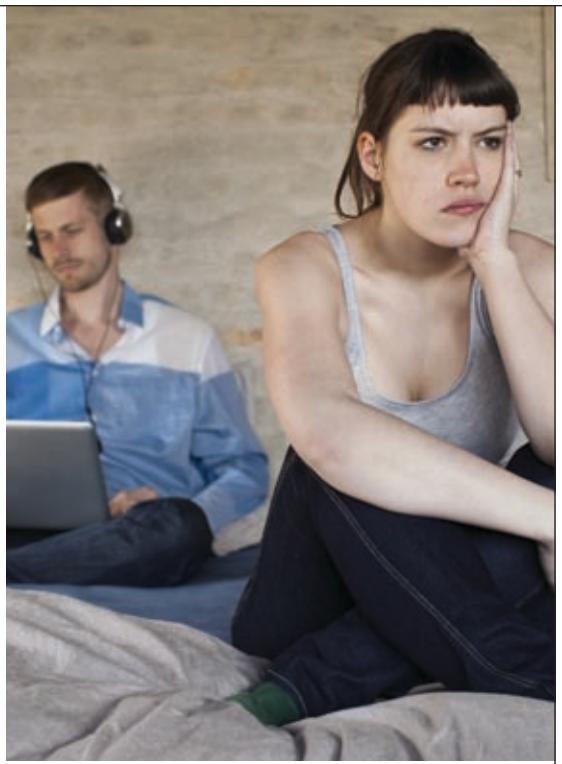
Therapy is not a pill you swallow to feel better; it is a delicate and complex process that reflects the patient's and therapist's unique personal qualities

More Than Just Talk

How the two major kinds of therapy differ

	Psychodynamic Therapy	Cognitive-Behavior Therapy
General Approach	Exploratory: The therapist facilitates self-examination and self-awareness	Educational: The therapist provides information, teaches skills, assigns homework
	The therapist treats the whole person	The therapist treats the symptoms or diagnosis
	Therapy emphasizes the examined life	Therapy emphasizes measurable results
	"Success" means not only symptom improvement but a richer, freer life	"Success" is often defined in terms of measurable outcomes such as questionnaire scores or frequency of behaviors
The Therapist's Own Therapy	Essential to deepen understanding of mental life and avoid playing out the therapist's own emotional issues with patients	Irrelevant unless the therapist has a mental illness
What Happens in Treatment	The assumption is that negative feelings have their own origins, independent of logic; feelings are accepted and worked with on their own terms	The assumption is that negative feelings are caused by "irrational" thoughts or beliefs; therapy aims at changing beliefs
	The patient is encouraged to follow thoughts and feelings where they lead	The therapist may direct the session or follow a preset agenda
	Considers the relationship between past and present	Emphasizes present-day situations
	The patient's emotional reactions to the therapist are viewed as opportunities to rework problematic relationship patterns	The patient's emotional reactions to the therapist may be viewed as distractions or interferences





Psychodynamic therapists identify recurring relationship themes and patterns. For example, a woman who felt ignored as a child (*far left*) may find herself having similar feelings in adulthood (*left*). Psychodynamic therapy can help free her from old patterns.

CORBIS (*left*); AGE FOTOSTOCK (*right*)

and interactions. The relationship between therapist and patient—what therapists call the "working alliance"—is critical to success.

In several 1996 studies Pennsylvania State University psychologist Louis Castonguay and his associates found that depressed patients improved more when the working alliance was strong and when therapy put patients on a trajectory of deepening self-examination that led to awareness of previously unconscious feelings and meanings—a core principle of psychodynamic therapy.

In contrast, attempting to change negative thoughts—a foundational feature of CBT—actually predicted worse results.

And in a study that at this writing was in press in the journal *Psychotherapy: Research, Theory, Practice, and Training,* leading psychotherapists and researchers teamed up to ask: What happens in therapy that helps or hinders progress? Over an 18-month period, patients and therapists separately filled out cards after each session, describing memorable interactions. According to therapists and patients alike, the most helpful interventions were those that yielded emotional, not just intellectual, insight.

Of particular note—given the field's knee-jerk approbation of cognitive-behavior therapy—is research conducted in the 1990s by the late psychologist Enrico Jones of the University of California, Berkeley. His team analyzed recordings of hundreds of therapy sessions, both psychodynamic and CBT. They found that the more the therapists drew on key psychodynamic principles such as addressing patients' avoidances or defenses, exploring emotions and fantasies, identifying recurring themes, and discussing the therapy relationship, the better patients fared—*in both psychodynamic and cognitive-behavior therapy*. In contrast, the use of bedrock CBT methods such as teaching skills and strategies or assigning homework showed no benefits.

In other words, when CBT was successful, it was largely because therapists departed from their official playbook and did the kinds of things psychodynamic therapists do.

Ultimately, there are basic truths of human psychology that most people understand intuitively. We do not fully know ourselves; the things we do not know can cause suffering; and there is benefit in self-awareness.

Psychodynamic therapy is based on these truths and has demonstrated its benefits scientifically. It's time for academic researchers to examine their resistance to the truth. M

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CROWD CONTROL

In emergencies, people don't panic. In fact, they show a remarkable ability to organize themselves and support one another

By John Drury and Stephen D. Reicher

Thousands of people used stairwells to exit the World Trade Center's 110-story Twin Towers before the buildings collapsed on September 11, 2001. The evacuation included acts of quiet heroism and self-sacrifice.

ROMAN SOUMAR *Corbis (preceding pages);* REUTERS/CORBIS *(this page)*

September 11, 2001. In the Twin Towers of New York City's World Trade Center, intense fires are burning in and above the impact zones struck by hijacked airliners. People evacuating from the 110-story towers realize they are in danger, but they are not in a blind panic. They are not screaming and trampling one another. As they descend the densely packed stairwells, they are waiting in line, taking turns and assisting those who need help. A few office workers hold doors open and direct traffic. Thanks to the orderly evacuation and unofficial rescue efforts, the vast majority of people below the impact zones get out of the buildings alive.

Not everyone was an angel on 9/11. But accounts of the Twin Towers evacuation show that there was none of the "mass panic" that many emergency planners expect to see in a disaster. In fact, when researchers look closely at almost any major disaster, they find little to support the assumption that ordinary people lose their heads in these extraordinary situations. Instead they find that individuals not only behave sensibly in emergencies but also display a solidarity that can be a valuable asset.

These results have important implications for emergency planning. They suggest that ordinary people should be viewed as "first responders" and given practical information about their situation so that they can make rational choices. Instead of seeking to herd people as if they were frightened sheep, emergency managers should facilitate the remarkable self-organizing capabilities of crowds.

The Myth of Mass Panic

The image of the panicked crowd is deeply ingrained in the popular imagination. Hardly any self-respecting Hollywood disaster movie would be complete without one scene of people running wildly in all directions and screaming hysterically. Television newscasters perpetuate this stereotype with reports that show shoppers competing for items in what is described as "panic buying" and traders gesticulating frantically as "panic" sweeps through the stock market.

The idea of mass panic shapes how we plan for, and respond to, emergency events. In Pennsylvania, for example, the very term is inscribed in safety regulations known as the state's Fire and Panic Code. Many public officials assume that ordinary people will become highly emotional in an emergency, especially in a crowded situation and that providing information about the true nature of the danger is likely to make individuals panic even more. Emergency management plans and policies often in-

FAST FACTS

When Someone Yells Fire

1» In disasters, people are more likely to be killed by compassion than competition. They often tarry to help friends or family members.

2» When a crisis hits in a crowded place, people often undergo a shift, identifying themselves more as group members than individuals.

3» Emergency planners can help ordinary people act as "first responders" by giving them practical information as the situation unfolds.

Event marshals may be instructed to report a fire using code words, to prevent people from overhearing.

tentionally conceal information: for example, event marshals may be instructed to inform one another of a fire using code words, to prevent people from overhearing the news—and overreacting.

Mathematicians and engineers who model "crowd dynamics" often rely on similar assumptions describing behaviors such as "herding," "flocking" and, of course, "panic." As the late Jonathan Sime (an environmental psychologist formerly at the University of Surrey in England) pointed out, efforts to "design out disaster" have typically treated people as unthinking or instinctive rather than as rational, social beings. Therefore, more emphasis is placed on the width of doorways than on communication technologies that might help people make informed decisions about their own safety.

These ideas about crowd behavior permeate the academic world, too. For many years influential psychology textbooks have illustrated mass panic by citing supposed examples such as the Iroquois Theater fire of 1903 in Chicago in which some 600 people perished and the Cocoanut Grove Theater fire of 1942 in Boston in which 492 people died. In the textbook explanations, theatergoers burned to death as a result of their foolish overreaction to danger. But Jerome M. Chertkoff and Russell H. Kushigian of Indiana University, the first social psychologists to analyze the Cocoanut Grove fire in depth, found that the nightclub managers had jeopardized public safety in ways that are shocking today. In a 1999 book on the psychology of emergency egress and ingress, Chertkoff and Kushigian concluded that physical obstructions, not mass panic, were responsible for the loss of life in the infamous fire [*see box on page 63*].

A more recent example tells a similar story. Kathleen Tierney and her coworkers at the University of Colorado at Boulder investigated accusations of panicking, criminality, brutality and mayhem in the aftermath of Hurricane Katrina. They concluded that these tales were "disaster myths." What was branded as "looting" was actually collective survival behavior: people took food for their families and neighbors when store payment systems were not working and rescue services were nowhere in sight. In fact, the population showed a surprising ability to self-organize in the absence of authorities, according to Tierney and her colleagues.

Audiences expect disaster flicks to have at least one scene of terror-stricken victims fleeing with mouths agape. The film *2012* was no exception. But reality differs from the movies.

SONY PICTURES ENTERTAINMENT/THE KOBAL COLLECTION

Such work builds on earlier research by two innovative sociologists in the 1950s. Enrico Quarantelli—who founded the Disaster Research Center at Ohio State University in 1985 and later moved with it to the University of Delaware—examined many instances of emergency evacuations and concluded that people often flee from dangerous events such as fires and bombings, because usually that is the sensible thing to do. A fleeing crowd is not necessarily a panicked, irrational crowd.

The second pioneering sociologist, Charles Fritz, was influenced by his experiences as a soldier in the U.K. during the World War II bombings known as the Blitz. "The Blitz spirit" has become a cliché for communities pulling together in times of adversity. In the 1950s, as a researcher at the University of Chicago, Fritz made a comprehensive inventory of 144 peacetime disaster studies that confirmed the truth of the cliché. He concluded that rather than descending into disorder and a helpless state, human beings in disasters come together and give one another strength. Our research suggests that if there is such a thing as panic, it probably better describes the fear and helplessness of lone individuals than the responses of a crowd in the midst of an emergency.

From "Me" to "We"

In our recent work, which includes both virtual-reality simulations and research into real disasters, we have found that people in a crowd develop a shared social identity based on their common experience during an emergency. This shared identity promotes solidarity, which results in coordinated and beneficial actions—or what we call "collective resilience." We have gathered two types of evidence that support this model.

Subway bomb survivors described feeling "unity," "affinity,"
"didn't matter what color or nationality."

When Hurricane Katrina devastated the Gulf Coast region in 2005, thousands were stranded without food, water or critical supplies. What was portrayed as looting was often a sensible and lifesaving response.

First we used computer game technology to conduct virtual-reality simulations of a fire at a rail station in the London Underground. Participants in the interactive simulations had the opportunity to push others out of the way to exit more quickly. They also had the opportunity to help others affected by the fumes, but at the cost of getting out more slowly. In some of the simulations, the participants were members of a common group (for example, fans of the same soccer team), whereas in other cases they were not (for example, shoppers bargain-hunting at sales). As expected, those who had shared identities before disaster struck had more solidarity: pushing less, helping more.

In a case of real life imitating virtual reality, we were conducting these experiments on July 7, 2005, at the Royal Society Science Exhibition in London, just as a real emergency unfolded in the train stations beneath us. In a coordinated terrorist attack, four bomb blasts hit London's public transport system during the morning rush hour. The explosions on three subway trains and a bus killed 56 people (including the four bombers) and injured more than 700.

In a virtual-reality simulation of a fire at a London tube station, people were more likely to help the man seen seated at the left when they were fans of the same soccer team.

Those in the bombed trains were literally left in the dark, among the dead and dying, with few announcements and no way of knowing when they would be rescued.

We gathered accounts from more than 140 people who were present during the bombings, including 90 survivors who had been onboard the trains. We coded these accounts to determine the prevalence of helpful behaviors—help given, received or observed in others—as well as personally selfish behaviors experienced or observed. "Helping" included acts such as sharing water, tying tourniquets and giving emotional support; selfish behaviors included elbowing other people out of the way and ignoring requests for help.

Just as being fans of the same soccer team united people, so, too, did the bombings. Most of our interviewees described a sense of togetherness among survivors that day. They used a rich vocabulary that highlighted positive feelings: "unity," "similarity," "affinity," "part of a group," "didn't matter what color or nationality," "you thought these people knew each other," "warmness," "empathy." They contrasted this sense of togetherness with the unpleasant feelings they typically experienced on busy subways.

The London bombings became one of many events we studied retrospectively for patterns of social identity. We also interviewed survivors of an earlier terrorist bomb attack in London (1983), a hotel fire (1971), a train accident (2003), the Hillsborough soccer stadium crush (1989), two

DAVE MARTIN *AP Photo (top)*; JOHN DRURY, CHRIS COCKING, STEPHEN D. REICHER, ANDY BURTON, DAMIAN SCHOFIELD, ANDREW HARDWICK, DANIELLE GRAHAM AND PAUL LANGSTON *(bottom)*

Blaming the Victims

Faulty exits, not stampeding patrons, caused an infamous tragedy at a Boston nightclub.

Textbooks often cite the Cocoanut Grove Theater fire of 1942 as a classic case of "mass panic." A nightclub with a dining room, dance floor and several bars, it was filled to more than twice its official capacity when a fire broke out on November 28, 1942. Few people knew where the exits were located. An emergency exit door was locked, and a large plate-glass window was boarded up.

Some patrons found an alternative exit and burst through it, carried along by a tide of people. But in the dining room on the main floor, hundreds tried in vain to get out through a jammed revolving door. "Those outside could do nothing to save them," according to social psychologists Jerome M. Chertkoff and Russell H. Kushigian of Indiana University, who analyzed the catastrophe in their book *Don't Panic: The Psychology of Emergency Egress and Ingress* (Praeger, 1999). In all, 492 people died from crushing or smoke inhalation.

Chertkoff, Kushigian and others who have studied the fire conclude the deaths were caused by blocked exits and poor building design, such as doors that opened inward. The club's owner was found guilty of involuntary manslaughter, and the fire led to new safety regulations. But decades later the myth of the panic-stricken crowd persists. *—J.D. and S.D.R.*

BETTMANN/CORBIS

skyscraper evacuations (2001 and 2002), the Bradford City soccer stadium fire (1985), a beach-concert party crush in Brighton (2002), the Ghana soccer stadium "stampede" (2001), and two sinking ships (*Jupiter* in 1988 and *Oceanos* in 1991). We asked independent judges to code the interviews, identifying the extent to which survivors described a feeling of common fate or threat; the degree to which people felt a sense of shared identity; and the prevalence of active helping, more mundane solidarity (acts of courtesy and routine civility), and selfish or competitive behaviors.

A clear pattern was demonstrated across the various events. Those who reported a feeling of common fate were more likely to report a strong sense of shared identity. They were also more likely to report cases of mutual helping. A similar relation was noted between a strong shared identity and more mundane acts, such as waiting in line. All the crowds seemed to display some unity after the onset of the emergency, even when they began as fragmented groups.

These accounts are consistent with social identity theory, first formulated by social psychologists Henri Tajfel and John C. Turner of Bristol University in the late 1970s. Social identity theory holds that group behavior cannot be explained simply by the psychology of individuals. As Tajfel and Turner pointed out, a person's sense of identity depends on the groups to which he or she belongs, and in times of crisis group identity can supersede individual identity.

The idea that a common fate can create a particular group identity comes from "self-categorization" theory, an articulation of social identity theory that Turner subsequently formulated. He found that people not only experience group identity but can shift among many different group and individual identities depending on the context in which they find themselves.

We have applied and extended these theories to help explain crowd behavior. On an average workday, for example, a subway rider might categorize himself or herself primarily as an individual, whereas his fellow commuters are "others." But in a crisis seen to affect everyone, the rider's identity may change from "me" to "us," which in turn leads to behavioral expressions of solidarity. Once people define themselves as group mem-

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bers, the fate of the group and of fellow members becomes important to them. And because of this sense of collective identity there are greater expectations of support, so members of the group feel less helpless than they would if they were facing the situation alone.

Ordinary Heroes

We know the stories of the heroic firefighters who lost their lives on 9/11 helping others to safety, but few people are aware of the essential role played by the evacuees themselves. As fire researcher Guylène Proulx of Canada's National Research Council, Ed Galea of the Fire Safety Engineering Group at the University of Greenwich in England and others have shown, the death toll was minimized because people in the crowd maintained or even increased "everyday" forms of civility during their mass exodus from the Twin Towers.

On the 88th and 89th floors of the North Tower, for example, an architect and a construction inspector used tools to clear rubble and break down doors. Their volunteer efforts enabled at least 50 people to escape from the building. The two men stayed behind to assist others and did not make it out alive.

Certainly there were some who just looked after themselves and ignored others in distress, but sometimes there are good reasons for such behavior. Sociologist Benjamin Cornwell of Ohio State University, who studied the 1994 sinking of the M/V *Estonia* passenger ship, concluded that some people were simply unable to help others during that disaster. It was physically difficult to get to the exits because of the extreme listing of the ship. Most did not have the strength to get there themselves, let alone assist others.

Perhaps the most obvious explanation for why we help others in emergencies is that we know them. So-called affiliation theorists such as Anthony Mawson, a professor of public health at Jackson State University, say that panic is rare because we are typically in the company of friends or family when disaster strikes. The presence of familiar others soothes us and counteracts our "fight or flight" instincts.

Jonathan Sime's study of the 1973 fire at the Summerland leisure center on the Isle of Man provides poignant support for this view. He showed that many people might have escaped but for the fact that they chose to stay in family groups, going at the pace of the slowest—a pace that was too slow for survival in some cases. Sime argues that people die together in emergencies not because they are competing but because they care for one another.

But the notion of affiliation cannot be the whole story. In emergencies such as the London terrorist bombings, people were among strangers but were nonetheless orderly, cooperative and even self-sacrificing. Sociologists who study disasters have shown that in an emergency, individuals remain committed to the same rules of conduct that govern everyday behavior.

A case in point is the lethal fire at the Beverly Hills Supper Club near Cincinnati in 1977. As fire spread through the building, the opportunities for exit became more and more restricted. In the end, 165 people lost their lives, but there was no mass panic. The 630 witness statements given to police provide rich insight into how people behaved. Certainly there was evidence of affiliation. People moved in family or friendship groups, and if one died the others were likely to die as well. But as a number of researchers—particularly sociologist Norris Johnson of the University of Cin-

Panic is rare because the presence of loved ones in a disaster counteracts our "fight or flight" instincts.

Real-time information delivered via public address systems or electronic signs—such as this one in Sydney, Australia (*left*)—can help people decide when and where to evacuate during emergencies. The surveillance cameras that officials use to monitor the vast annual pilgrimage to Mecca by Muslims (*right*) are meant to provide early warning signs of potentially dangerous overcrowding.

TIM WIMBORNE *Reuters/Corbis (left)*; KAZUYOSHI NOMACHI *Corbis (right)*

cinnati—have shown, social norms were observed. The staff continued to look after customers, with waiters attending to the safety of those at their assigned tables. The customers observed normal courtesies, such as allowing the elderly to go first. As the seriousness of the situation became more evident, there was an increase in competitive behaviors. But Johnson reports that even at the most urgent stages of the evacuation, social bonds remained largely intact; people picked one another up when they fell, for example.

The conclusion: continuity exists between everyday behavior and emergencies. Regardless of whether people think of themselves as individuals or as part of a community, they observe social norms. Human beings do not forget themselves, their values or their obligations to others both close and distant. They do not turn into savages desperate to escape. Disasters bring out the best—not the *beast*—in people.

Chilean miners trapped half a mile or so underground used a tiny camera to take pictures of themselves earlier this year. The group of 33 workers has impressed rescuers with their organization and unity.

ARCHIVOLATINO/REDUX PICTURES

Free Flow of Information

If models of crowd behavior are to be more psychologically accurate and hence more useful at predicting how people will behave in an emergency, they must include dynamic "group membership" variables. The shared social identity of any group can be the basis for an efficient and orderly evacuation, rather than a source of pathological "panic."

For example, the social solidarity of 33 Chilean miners recently trapped nearly half a mile underground has played an essential role in maintaining their physical and mental health as they await rescue. (As of August, they were facing a four-month wait.) The miners organized their own chapel services and a "buddy system" of three-person teams, and they began eating each meal only after rations for everyone had been painstakingly lowered through a hole. A miner who had taken a nursing course monitored the group's health and administered tests and vaccinations. The miners aided rescue efforts by preparing a map of their surroundings and clearing rocks.

Evidence suggests that the single biggest killer in emergencies is lack of information—for example, when people do not evacuate promptly because they do not realize the danger. Live public address systems are more effective than sirens and alarms for providing credible information about the nature and location of the danger. In places where there is a danger of overcrowding, video monitoring can provide early warning signals.

Emergency planners should encourage collectivity, not fear it. Disasters tend to bring people together, but other social forces often divide people. Even the language that is used to address groups in public spaces may make a difference. Addressing people as "customers," for instance, emphasizes an individual financial relationship and has been shown to encourage competitive behavior. Addressing people instead as members of a group—"passengers" or "citizens," for example—may help prevent them from competing with one another in a rush for the exits.

Emergency planners need to consider ordinary people their best asset rather than their worst nightmare. Instead of undermining people's natural tendency to organize and help one another, authorities can facilitate it by providing practical information—such as exit routes that are clearly marked with arrows and reflective paint. When ordinary people are asked to take increased responsibility for their own survival and well-being, they can do extraordinary things. M

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Dog Tired

What mutts can teach us about self-control

BY WRAY HERBERT

MATT MENDELSON (*Herbert*); GETTY IMAGES (*dog*)

WE HUMANS LIKE to think that we have much more self-discipline than other animals. We know how to set goals—losing 25 pounds, starting our own businesses—and then we resist temptations and slog through difficulties to achieve them. We are far from perfect at this talent, but in most of our minds there is no question that our powerful self-control is one of the things that sets us apart from more lowly beasts.

Scientists have long argued that delaying gratification requires a sense of "self." Having a personal identity allows us to compare who we are today, at this very moment, with who we want to be—an idealized self. Such aspirations are thought to foster the kind of behavior that leads to self-improvement. But new research suggests a more primitive source of our powers of self-discipline. It appears that, lofty as our goals may be, we rely on the same basic biological mechanism for self-discipline as our four-legged best friends.

Sit. Now Stay.

Experimental psychologist Holly Miller and her colleagues at the University of Kentucky knew from previous research that in people, self-control relies on the brain's "executive" powers, which coordinate planning and action. It is further known that this kind of effortful cognitive processing requires energy in the form of glucose, the simple sugar that serves as the body's fuel. Studies show that depletion of the brain's glucose supply compromises self-discipline. For instance, passing up a tempting happy-hour drink after work may make it tougher to forgo your favorite television show later on that evening to exercise. Of course, all mental activities require energy, but self-control seems to be one process that is especially compromised when the energy starts running out. But is this a uniquely human phenomenon?

To find out, Miller recruited a group of dogs ranging in age from 10 months to more than 10 years old. Some were purebreds, such as Australian shepherds and vizslas; others were mutts. All the dogs were familiar with a toy called a Tug-a-Jug, which is basically a clear cylinder with treats inside; dogs can easily manipulate the Tug-a-Jug to get a tasty pay-

The dogs that had **exerted self-control** gave up trying to get at a treat much more quickly than those that were not exhausted.

off. In the experiment, some of the dogs were ordered by their owners to "sit" and then "stay" for 10 minutes. That's a long time to sit still; it was meant to exhaust the animals mentally and thus to deplete their fuel reserves. The other dogs, the controls, merely waited in a cage for 10 minutes.

Then all the dogs were given the familiar Tug-a-Jug, except that it had been altered so that it was now impossible to get the treats out. The hungry dogs could see and hear the treats—but they could not get at them. The idea was to see if the previous demand for self-discipline made the dogs less, well, dogged in working for the treats. And it did, unmistakably. Compared with the dogs that had simply been caged, those that had willed themselves to stay still for 10 minutes gave up much more quickly—after less than a minute, as opposed to more than two minutes of effort from the controls. In other words, it seemed as though exerting self-discipline had used up much of the dogs' blood sugar supply—weakening their brain's executive powers and diminishing the animals' ability to exert goal-directed effort.

Delaying gratification to meet long-term goals may seem to require advanced cognition, but the process is governed by the same mental processes that allow dogs to obey commands.

AGE FOTOSTOCK

Sugar-Powered Discipline

Executive powers? In old Shep? These findings suggest that self-control may not be a crowning psychological achievement of human evolution and indeed may have nothing to do with self-awareness. It may simply be biology—and beastly biology at that. These are humbling results, so the scientists decided to double-check them in a different way. In a second experiment, they recruited another group of dogs, this time made up of Shetland sheepdogs and border collies. As before, some of the dogs sat and stayed for 10 minutes, whereas the others were caged. But this time half of the obedient dogs got a sugar drink following the exercise, whereas the others got an artificially sweetened drink. Miller wanted to see if she could restore the dogs' executive powers by refueling their brains.

And that is exactly what happened. As reported in the April issue of the journal *Psychological Science*, the dogs that exerted self-control and then got replenished with sugar performed just like the dogs that had not been exhausted to begin with. They persisted with the Tug-a-Jug, even though it was frustrating and demanding to do so. The depleted dogs that had not received the sugar drink gave up much more quickly. In short, all the dogs acted the way that humans do in similar situations requiring restraint and goal-directed activity.

So perhaps humans are not unique—at least not in this regard. It appears that the hallmark sense of human identity—our selfhood—is not a prerequisite for self-discipline. Whatever it is that makes us go to the gym and save for college is fueled by the same brain mechanisms that enable our hounds to sacrifice their own impulses and obey. M

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

WRAY HERBERT is senior director for science communication at the Association for Psychological Science.

(Further Reading)

◆ **Self-Control without a "Self"?: Common Self-Control Processes in Humans and Dogs.** Holly T. Miller, Kristina F. Pattison, C. Nathan DeWall, Rebecca Rayburn-Reeves and Thomas R. Zentall in *Psychological Science,* Vol. 21, No. 4, pages 534–538; April 2010.

books

Through the Language Glass

by Guy Deutscher. Metropolitan Books (Macmillan), 2010 ($28)

Do we see the world differently depending on which language we speak? In the 19th century researchers assumed that people were unable to grasp concepts if there were no words in their language to describe them. This idea was largely debunked, however, in the late 20th century, when linguists concluded that it is possible to describe any concept in any language, given enough effort and time. But as Guy Deutscher argues in his new book, our mother tongue may still shape our worldviews, not because of what its speakers are able to express but because of what its speakers are *forced* to express.

Although Deutscher's book starts slowly—the first half is more history than current science—the pace picks up as he describes intriguing linguistic idiosyncrasies and explains their potential effects on cognition. For one thing, linguistic rules influence how much information a person must convey. In English, you might be able to discreetly tell a friend that you "spent the evening with your neighbor," and you aren't forced to reveal whether this neighbor happened to be a man or a woman. The French and Spanish languages, however, as well as others, including German and Russian, have different words for "female neighbor" and "male neighbor," so linguistic convention would require you to reveal that potentially interesting detail.

Guugu Yimithirr, an Aboriginal Australian language, requires speakers to develop a nearly perfect sense of direction. In its conventions, instead of right, left, front and back, a constant, almost intuitive knowledge of north, south, east and west is used to convey all spatial information. You might be warned about "the ant to the north of your foot" or told that "the fish is sold in the northeast corner of the store." Deutscher argues that this compasslike sense of direction affects memory and perception. For instance, if two identical photographs are placed side by side, English and Guugu Yimithirr speakers will say they look the same. But if one photograph is rotated 90 degrees to the left and the other is rotated 90 degrees to the right, the Guugu Yimithirr speaker will no longer view them as identical, because the objects they portray are facing entirely different directions. "Two realities that for us can look identical will appear different to them," Deutscher writes.

Finally, the words that a particular language uses to describe colors can affect visual perception. As Deutscher explains, studies suggest that people can see a difference between colors that have different names more quickly than they can detect a difference between two shades of the same color. Ultimately, Deutscher admits, it's unclear exactly how strongly these—or other as yet undiscovered—habits of speech might affect us. But language may well be another lens distorting our view of the world.

—Melinda Wenner Moyer

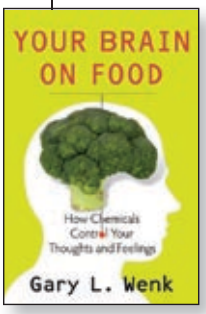
Your Brain on Food—How Chemicals Control Your Thoughts and Feelings

by Gary L. Wenk. Oxford University Press, 2010 ($29.95)

Nutmeg induces LSD-like hallucinations. That is, if you eat an entire container in one sitting, according to neuroscientist Gary L. Wenk in his book *Your Brain on Food.* He also explains why we crave chocolate—it contains fats that cause our bodies to release mood-enhancing chemicals—and why coffee may be good for us: drinking five to six cups a day may prevent Parkinson's disease and diabetes.

But if you're hoping the book will live up to its title and explain how a range of foods alters your brain, you'll be sorely disappointed. Wenk spends very little time discussing food beyond these brief mentions of spices, coffee and chocolate. Instead he focuses almost exclusively on how the brain responds to drugs.

If you can get over the misleading title, the book makes for an interesting read. Wenk describes how cocaine, marijuana and LSD alter the flow of brain chemicals such as dopamine and serotonin. Wenk explains, for example, that the brain's response to marijuana may alter as we age. In the young brain, marijuana impairs the ability to retain memories because of the chemical THC. THC binds to and activates specific neuronal receptors that control memory and concentration. But studies suggest that as we age, the drug may actually have the reverse effect, helping the brain preserve memories. Although Wenk does not describe the precise reason why, he suggests that the drug reduces inflammation and possibly even stimulates new brain cells to form.



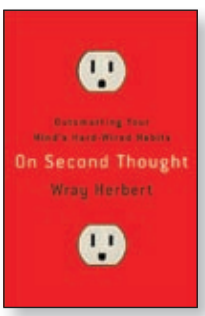
Wenk also links mind-altering drugs to spirituality. In ancient times, religious leaders regularly used hallucinogenic plants in an attempt to communicate with the gods. Recent studies suggest these plants cause hallucinations because they reduce serotonin sensitivity, causing the brain to become overloaded with sensory information. This confusion can create the sensation that one is floating in space or communicating with a higher power. To support this idea, several studies have even shown that people whose brains contain a low number of a type of serotonin receptor tend to be more religious.

Tidbits such as this keep Wenk's journey through your brain intriguing and highlight how easy it is for the chemicals we ingest and those we produce naturally to modify the way we think, feel and act.

—Nicole Branan

On Second Thought: Outsmarting Your Mind's Hard-Wired Habits

by Wray Herbert. Crown Publishers, 2010 ($25)



Baby sea turtles don't sit around pondering what to do after they hatch—they head straight for the safety of the ocean. Like sea turtles, humans rely on their instincts to survive, although we have evolved a more cerebral set of tools to do so. As Wray Herbert, a longtime contributor to *Scientific American Mind,* explains in his new book *On Second Thought,* we depend on hardwired mental shortcuts called heuristics to help us make decisions and solve problems efficiently.

For instance, when we walk into a new restaurant, we don't have to waste time figuring out what to do next. We instinctively know to wait for a table, sit down, look at the menu and then order our food. Similarly, when faced with an endless choice of cereals, we reflexively

reach for the product we know we like instead of pacing up and down the aisle comparing every last box.

But sometimes heuristics can lead to illogical reasoning or bad decisions. Consider what Herbert calls the cooties heuristic—an aversion to something we believe is contaminated. This mental shortcut helps us, and helped our ancestors, avoid infection and food poisoning—but we can take it too far. In one study, psychologists asked people whether they would be willing to wear a sweater Adolf Hitler once wore. Although no such sweater exists and no article of clothing could transfer Hitler's personality, most participants adamantly refused.

And there's the scarcity heuristic, which says that if something is rare it must be valuable and, conversely, if something is valuable it must also be scarce—a guideline that makes sense for prized materials, such as gold or precious reserves of food in lean times. Still, this rule of thumb can lead us to hopeless conclusions. The scarcity heuristic helps to explain why we often think that a good man or woman is hard (if not impossible) to find. Using this logic, some people just give up the search for a mate, even though they couldn't possibly have exhausted every option.

"Heuristics are neither good nor bad all the time," Herbert admits. "It's all about getting the balance right." The key to that balance, according to Herbert, is recognizing that mental shortcuts exist in the first place. To help us become aware of our snap judgments and avoid the irrational ones, Herbert divulges 20 different heuristics in 20 chapters and discusses their pros and cons.

At times, *On Second Thought* feels like a rundown of mental heuristics with only vague advice on how to avoid the pitfalls. So skipping to the particular topics that interest you most may be wise. In other words, take your own shortcuts.

—Ferris Jabr

» Sex Education

No matter how old and experienced we get, sex and romance never fail to surprise and perplex us. Three new books explore the origins of human sexuality, whether we are capable of monogamy, and why we kiss.

Husband and wife Christopher Ryan and Cacilda Jethá travel back in evolutionary time in ***Sex at Dawn: The Prehistoric Origins of Modern Sexuality*** (HarperCollins, 2010) to reveal that modern humans evolved from hunter-gatherers who lived in intimate groups and shared everything—food, chores and even sexual partners. Thus, Ryan, a psychologist, and Jethá, a psychiatrist, argue that we are hardwired to seek multiple partners and that these natural promiscuous urges may explain why half of marriages in the U.S. end in divorce.

Monogamy is not necessarily a natural state for humans, agrees clinical psychologist Marianne Brandon in ***Monogamy: The Untold Story*** (Praeger, 2010). Brandon thinks modern society creates unrealistic gender roles—for instance, an ideal man needs to be both sensitive and powerful—and these roles encourage both men and women to repress their sexual instincts. But the key to successful monogamy, Brandon argues, is to use those primal impulses to stoke the flames of desire with your committed partner.

In ***The Science of Kissing: What Our Lips Are Telling Us*** (Grand Central Publishing, 2011), biologist and science journalist Sheril Kirshenbaum explores all aspects of a lip lock. For instance, women usually require a kiss to feel intimate with another person, whereas men are more willing to forgo the first kiss and go straight for sex. Although scientists don't know why we kiss, Kirshenbaum explores several possibilities, such as that kissing rekindles the intimacy we first experienced in infancy when breastfeeding.

—Ferris Jabr

How Many Friends Does One Person Need? Dunbar's Number and Other Evolutionary Quirks

by Robin Dunbar.
Harvard University Press, 2010
($27.95)

If you find relationships challenging to cultivate and maintain, then you are in good company. In his new book, evolutionary biologist Robin Dunbar argues that our ability to manage such complex social connections—love lives, work colleagues, childhood buddies and friendly acquaintances—is what drove humans to develop such large brains in the first place.

Dunbar finds support for this theory, dubbed the social intelligence hypothesis, by observing birds. He recently conducted studies in several species of birds and found a clear link between brain size and relationship type. Birds that mate for life have much larger brains relative to body size, whereas birds that live in promiscuous flocks have much smaller brains. Dunbar speculates that birds with smaller brains have many short-lived partners because they lack the mental prowess to form and maintain more complex emotional bonds.

Dunbar finds that apes and monkeys form lasting bonds and have a particularly big neocortex—a region of the brain that regulates emotions, awareness of others and language abilities. Humans form some of the most intricate and complex relationships of all. And our brains are high maintenance, consuming a whopping 20 percent of our energy.

Judging from human brain size and complexity, Dunbar calculates that a person's social group should incorporate about 150 people—this is the maximum number of relationships our brain can keep track of at one time. This figure, now graced with the name "Dunbar's number" takes different types of relationships into account. On one end of the spectrum, we have a core group of about five people we talk to once a week. On the other end, we have a group of around 100 acquaintances to whom we speak about once a year.

Dunbar's theory may appear to fall short when you think of the masses of people you know at your church or the hundreds of friends you have on social network sites such as Facebook, but Dunbar claims that the more friends you have beyond his number, the less likely you are to know much about them—or if you can even call them friends.

—Frank Bures

GETTY IMAGES (*blocks*)

askthe**Brains**

How do we "see" with our eyes closed when we are dreaming?

—Robert J. Evans, via e-mail

Robert O. Duncan, *a behavioral scientist at York College, the City University of New York, explains:*

AS YOU SUGGESTED by the phrasing of your question, people don't actually see in their dreams. Sight depends on light entering the eye and stimulating the retina—something that doesn't happen when we are lying in the dark with our eyes shut. Nevertheless, studies that compare the vivid imagery of dreams with daytime vision reveal similar patterns of activity in the visual cortex, the largest brain area devoted to vision.

That is why some researchers believe dream visions come from visual centers in the brain. In the mid-1970s dream researcher J. Allan Hobson and his colleagues at Harvard Medical School proposed that the brain spontaneously generates electrical pulses while dreaming. These signals, known as PGO waves, originate in the visual cortex and in two other visual regions of the brain: the pons and the lateral geniculate nucleus.

PGO waves are most prominent during rapid eye movement (REM) sleep, the part of sleep when most dreaming occurs. The spontaneous activity from PGO waves may start in the visual areas of the brain but ultimately creates a cascade of activity that taps into the brain regions that house memories.

But not all investigators agree that dream imagery originates in visual areas. Several dream researchers have proposed the opposite path, suggesting that dreams originate in the regions that store memories and then connect to visual brain areas. This theory would explain why dream images are only as detailed as our memories.

For instance, let's say you are thinking of your grandmother. Your memory of her might not include the mole she has on the right side of her face, something you would clearly see if you were sitting next to her. The lack of detail that is characteristic of memory occurs also in dream visions.

Why do we use facial expressions to convey emotions?

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

JUST AS A PICTURE is worth a thousand words, our faces can express a wealth of information. The ability to communicate subtle emotions with a simple raised eyebrow or curl of the lip may be innate. Charles Darwin was one of the first to propose this theory in his book *The Expression of the Emotions in Man and Animals,* published in 1871, in which he wrote: "The young and the old of widely different races, both with man and animals, express the same state of mind by the same movements."

Recent work supports Darwin's theory that smiles, grimaces and more nuanced expressions are hardwired—an artifact of living in social groups. For example, studies show that infants, including those who are blind or have underdeveloped brains, use facial cues to tell their parents how they feel. Infants communicate with their faces even before they are old enough to understand the meaning of their own expressions. Because humans depend on one another for survival, we must communicate; facial expressions may have evolved as efficient ways to telegraph feelings and intentions.

Although using facial expressions to convey emotions may be largely instinctive, there is also a learned component. Japanese women and men, for instance, are taught to mask overt displays of emotion in favor of a socially acceptable smile.

Recent work supports Darwin's theory that smiles, grimaces and more nuanced expressions are hardwired—an artifact of living in social groups.

By studying faces, researchers have matched subtle changes in the positioning of the mouth, eyes and eyebrows to variations in six basic human emotions—happiness, surprise, disgust, sadness, anger and fear. Scientists are using this information to develop computer technology that analyzes facial movements and tics to help assess the veracity of suspects' testimony.

Facial expressions do not just give us away; they may also allow us to experience our own emotions more fully. This process is still not well understood, but it is possible that forcing your face to express happiness, sadness or anger may help you feel those emotions. In addition, new research using MRI reveals that facial expressions not only reflect what people are feeling, they influence it, too. Studies have shown, for example, that when people make an angry face, they exhibit less activity in regions of the cerebral cortex associated with empathy and decision making. M

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

COURTESY OF ROBERT O. DUNCAN; COURTESY OF MARK A. W. ANDREWS

Head Games

Match wits with the Mensa puzzlers

1 DEDUCTION

Find the five-digit number in which the second digit is three times the first, the third is one more than the second, the fourth is four times the first, and the last is one half more than the second. (Hint: There are no zeros in the number.)

2 WORD MORPH

Transform BEAR into WOLF in nine steps, by changing one letter at a time, making a real English word in every step. (Several solutions may be possible.)

BEAR

_ _ _ _

_ _ _ _

_ _ _ _

_ _ _ _

_ _ _ _

_ _ _ _

_ _ _ _

_ _ _ _

WOLF

3 ANAGRAM

The following sentence contains two missing words that are anagrams of each other. Find the correct 10 letters to fill in the blanks to make a sensible sentence.

The situation has reached a stalemate: total _ _ _ _ _ _ _ _ _ _. Each opponent now considers the other to be a worthy _ _ _ _ _ _ _ _ _ _.

4 LOST LETTER

The following groups of letters are the remnants of words after one particular letter was removed and the remaining letters scrambled. Find the missing letter and unscramble the words. (Hint: The letter appears more than once in each word.)

S U I E T O N E U E A I O R

5 ADD IN

Fill in the missing digits to make the arithmetic problem true. All the numbers from 1 to 9 appear once and only once.

```
  1 _ 9
+ _ 3 _
-------
  5 _ _
```

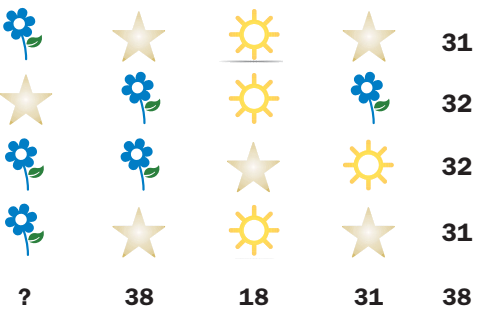
6 MANY WINDS

Take the five letters in WINDS and arrange them in the square shown at the right so each of the five letters can be found in every row, column and diagonal from corner to corner.

				D
D				
W	D			

7 SYMBOLIST SUM

In the grid at the right, each symbol represents a numerical value, and the values on each line have been added (across, down, and in one diagonal), except one. What is the value of the missing sum?



8 MAGIC SQUARE

Complete the magic square where the rows total 39 in all directions: across, down, and diagonally from corner to corner. No number may be used twice. The lowest number in the square is 8; the highest is 18. Three numbers have been filled in to get you started.

17		
	13	
		9

Answers

1. 26,789.
2. One possible solution: Bear, Boar, Boat, Bolt, Boll, Bull, Gull, Gulf, Golf, Wolf.
3. STAGNATION, ANTAGONIST.
4. Mummies, Momentum, Memoriam.
5. 129 + 438 = 567
6.

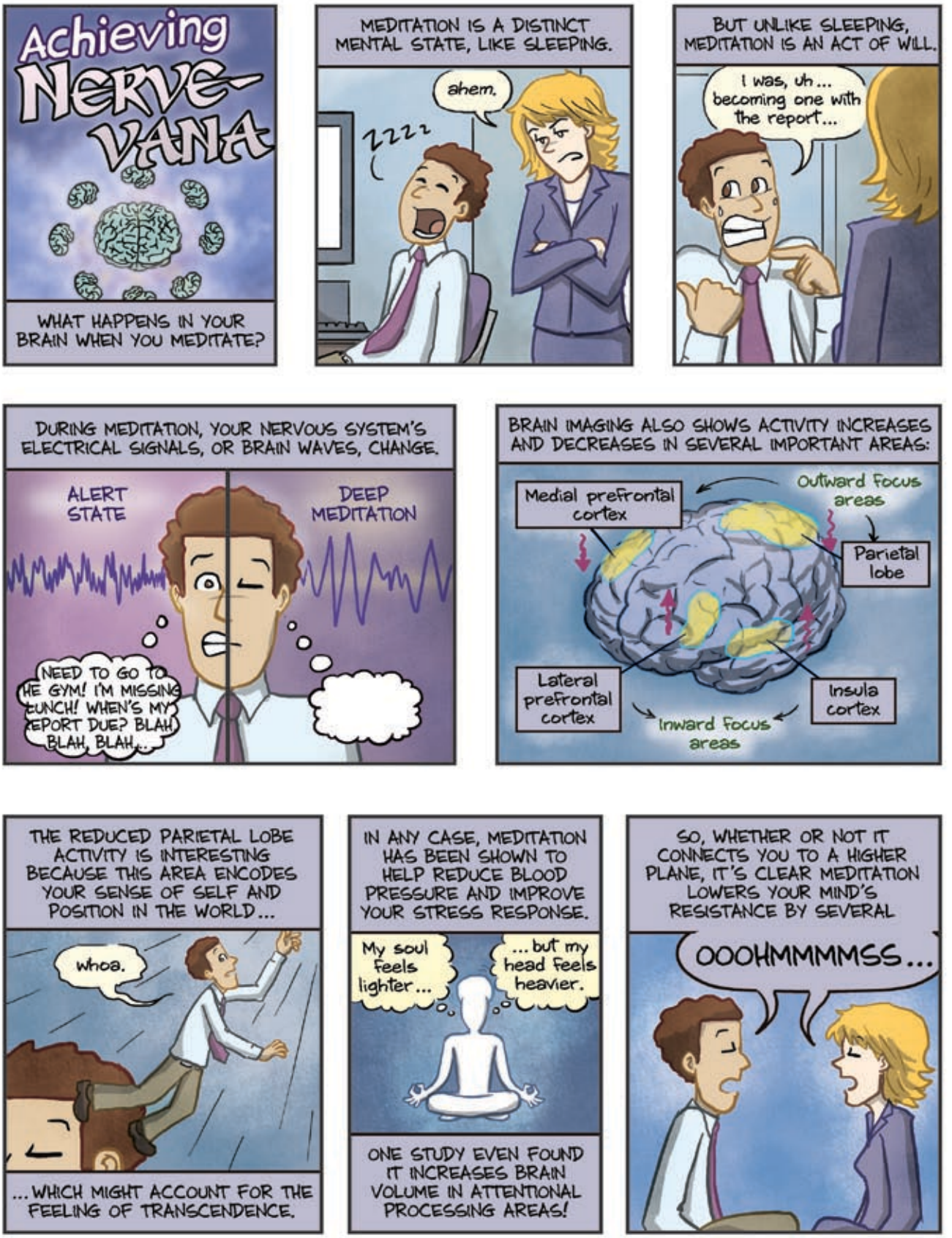
N	I	S	W	D
S	W	D	N	I
D	N	I	S	W
I	S	W	D	N
W	D	N	I	S

7. 39 (sun = 3, star = 9, flower = 10).
8.

17	10	12
8	13	18
14	16	9

or

17	8	14
10	13	16
12	18	9



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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