

SPECIAL ISSUE: MALE VS. FEMALE BRAINS

SCIENTIFIC AMERICAN  
**MIND**

BEHAVIOR • BRAIN SCIENCE • INSIGHTS

May/June 2010

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You Still Don't  
Understand

Men and Women Talk  
page 54

SPECIAL ISSUE

**HIS  
BRAIN**

How we're  
different

**HER  
BRAIN**

**Plus:**

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Parenting**

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a Truck

**Make Me  
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Humor and  
Romance

**Angry Men**

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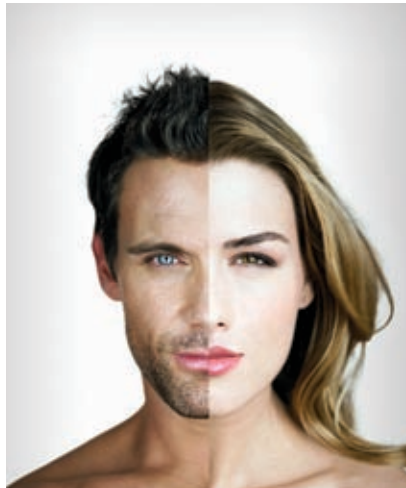
*Some of the articles in this issue  
are adapted from articles originally  
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## His and Hers

Mars and Venus. Pink and blue. As the stereotypes would have it, men and women have little in common but the ability to procreate. But how grounded in scientific reality are our culture's notions about the ways the sexes diverge? And what does the influence of gender mean for our minds—for how we think and communicate?

We at *Scientific American Mind* wanted to know, too. So, in a first for the magazine, the editors have devoted an entire issue to this topic of gender and the brain. The articles look at male-female differences—and also some perhaps surprising similarities. “He Said, She Said,” by linguist Deborah Tannen, for instance, explains how all conversations and relationships between couples involve a combination of hierarchy and connection. Women’s and men’s conversational styles turn out to be different ways of reaching the same goals. Turn to page 54 for more.

You probably have heard of Tannen before. Her 1990 book, *You Just Don't Understand: Women and Men in Conversation*, sparked national discussion and became a fount of rich material for late-show comics—especially variations on why men avoid asking for directions. In another feature article, “The Humor Gap,” starting on page 38, Christie Nicholson takes a serious look at what’s so funny about humor to men and women. Jokes in new relationships work to attract a love interest. Women find funny men sexy, and they laugh more than men—a gesture of connection. Later, couples may make jokes to smooth their way over life’s rough patches.

Partners who start families also display their own styles as parents. You’ve heard of the “mommy brain,” but did you know that fathers also undergo biological changes after their baby is born? Dads challenge their children; moms coddle them. For the kids, the two approaches create a winning combination. See “Family Guy,” by Emily Anthes, which begins on page 46.

As the French expression goes: *vive la différence*. It’s learning about the ways that we differ that often makes us grow together as a human species.

Mariette DiChristina  
Editor in Chief  
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COVER PHOTOILLUSTRATION BY ARON GOODMAN; HAIR AND MAKEUP BY ELIZABETH YOON

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The preference for playing hockey, or house, is far from fixed. Sex differences in the brain are small—unless grown-up assumptions magnify them.  
BY LISE ELIOT



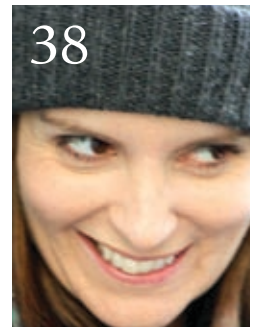
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Women get sad. Men get mad. Depression comes in many hues.  
BY ERICA WESTLY



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Women and men speak their own languages, but research reveals the conversational gender divide is not as stark as it seems.  
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Transsexuals are illuminating the biology and psychology of sex—and revealing just how diverse the human species really is.  
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### HATING "LOVE"

**After reading** Robert Epstein's article "How Science Can Help You Fall in Love," I had to go back to the cover and verify that the word "scientific" was indeed part of the title of your magazine. The "Love-Building Exercises" he recommends are more appropriate to a magazine of fantasy and science fiction:

"Two as One"—feeling that the two of you have merged?

"A Mind-Reading Game"—wordlessly trying to communicate thoughts?

"Love Aura"—feeling "eerie kinds of sparks" when your palm is close to another's?

Thought transfer? Auras? Come on! Shame on you for publishing such metaphysical pseudoscientific psychobabble!

**Harriet Hall**  
via e-mail

### ALONE TIME

**In "Are Social Networks** Messing with Your Head?" David DiSalvo rightly pointed out that social networking may affect the quality of our relationships; however, he missed the possibility that it can also affect the quality of our solitude. The reflection, quietude and introspection so vital to self-knowledge and creativity are too easily sapped away

when we can be reached at any time, anywhere, by everyone.

The richness of information and accessibility social networks offer is potentially wonderful. But it may also create an environment where people lack the time or willpower to take even a few minutes of solitude. Surely, this aspect also might profoundly affect our psychological well-being.

**J. Ramsey Golden**  
Anchorage, Alaska

### THOUGHTS ON SUICIDE

**I have to take issue** with the writing in the article "Daring to Die," by Karen Springen. The headline and the statement that to commit suicide people "need the guts" to go through with the act are practically egging people on. Are you "daring" enough to pull the trigger? Do you have the "guts" to do it? I think it is good to write openly about suicide, but I feel we should be careful to avoid glamorizing language.

**Kathleen Dyson**  
via e-mail

**Springen rightly notes** that restricting the means by which people commit suicide can result in fewer deaths. But she also says, "When a net went up under the Golden Gate Bridge, people could not jump to their deaths." There *is no net* under the Golden Gate Bridge. It remains the deadliest structure on earth for suicide. Those of us who have lost our loved ones to the bridge (my 17-year-old daughter and only child jumped in January 2008) are fighting to install a net. It has been an uphill battle because of political inertia and public apathy.

**John Brooks**  
Tiburon, Calif.

**EDITORS' NOTE:** Many readers wrote to correct this regrettable error. Our thanks to all of them for pointing it out. Please see *Errata* below for more details.

### HISTORY LESSONS

**I read with interest** "I Learned It at the Movies," by Wray Herbert [We're Only Human]. I have a 12-year-old son

who is fascinated by military history. We often watch movies together just for the camaraderie. After we watch films such as *Saving Private Ryan*, *Braveheart*, *The Patriot*, *Gettysburg*, and so on, we both do independent research for a few days and then discuss the accuracy of the movie. My son takes great pleasure in one-upping me during the reality check. I don't think that without the movies I could get him to research a topic I "assigned." Debunking is educational!

"ajbock"

commenting at

www.ScientificAmerican.com/Mind

**DEPRESSION AS A TOOL**

**I was fascinated** by your recent article "Depression's Evolutionary Roots," by Paul W. Andrews and J. Anderson Thomson, Jr. But it left me with a question. How does the model of depression as a problem-solving adaptation account for depression caused by an irreparable social situation (such as the death of a loved one)? Rumination cannot resolve the problem, because these sorts of situations are unresolvable. I have seen many of my high school classmates become depressed over the loss of a close family member. How does this type of depression fit your model?

Tovah Cowan  
via e-mail

**THE AUTHORS REPLY:** Bereavement may seem, at first glance, to be a situation where intense rumination is maladaptive because one cannot "undo" the past. An event that cannot be undone, however, often causes other important problems that rumination may be designed to deal with. The loss of a loved one means losing crucial emotional or material support, creating new difficulties that may take months or years to surmount. The analysis that takes place in depressive rumination can help bereaved people effectively manage some of these problems and rebuild support in their social network. Although a loss might be truly irreplaceable, usually new relationships can be forged with people who can fill at least some of the roles of the lost loved one.



**As one who has struggled** with bouts of major depression since childhood, I find the notion that there is something "adaptive" about it bewildering. Granted, the term is used to describe a wide range of negative feelings, some of which surely are caused by real-world situations—and, therefore, sadness may force people to analyze the roots of their problems and find rational solutions.

But then there exists a much darker kind of depression that acts as a kind of *lens* through which the entire world is perceived. The most insidious aspect of this state is the conviction that "I'm perceiving myself as worthless not because of an emotional disorder but because I'm finally facing up to reality: there truly is no hope." In this state of mind, the knowledge that "I've felt this way before, and things have gotten better" is utterly beside the point—that is surely not true this time.

The mood that accompanies this worldview is one of pure agony, and it certainly does not enable the sufferer to engage in a healthy analysis of real problems: indeed, the only rational course of action—assuming one has the energy—seems to be suicide. It is hard to consider anything about this mood disorder as adaptive!

Laura Lakin  
New York City

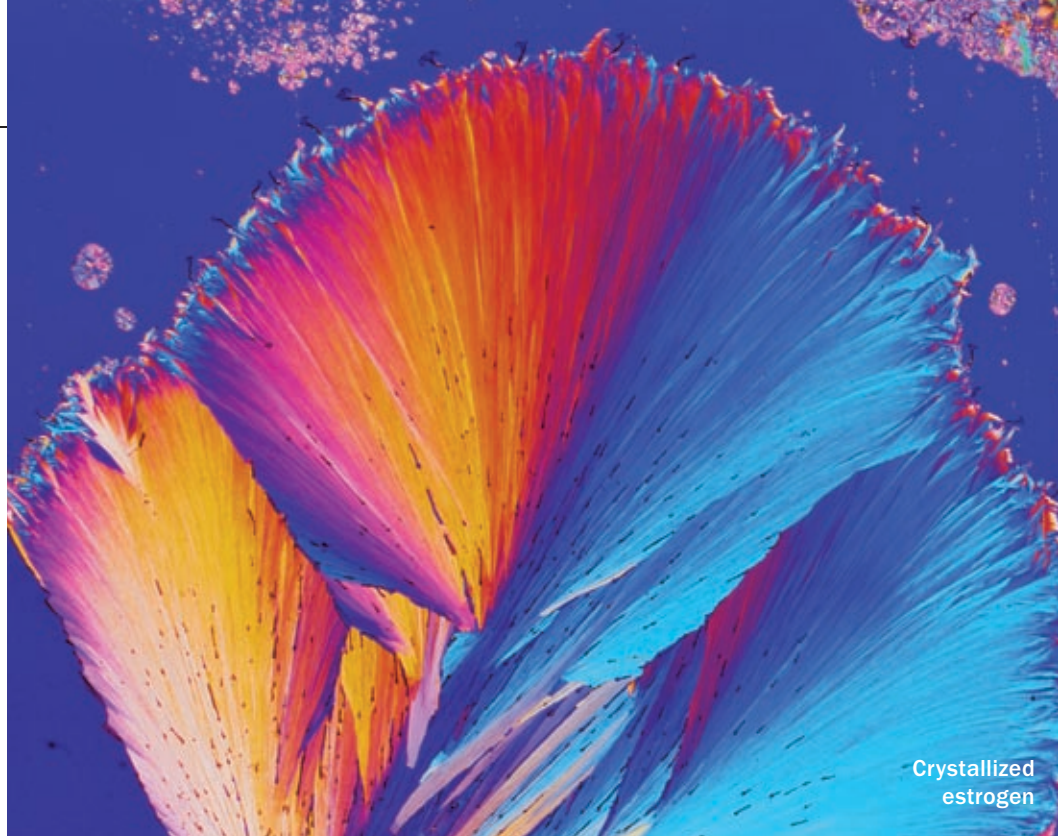
**THE EDITORS REPLY:** Many readers wrote to us with similar concerns, pointing out that their experience of depression (or that of their loved ones) was so traumatic and debilitating there was surely nothing beneficial about it. As the authors note, some diagnoses of depression may be true instances of the disorder, but many, many more cases are not. According to Andrews and Thomson, "We simply believe that depression is overdiagnosed as a disorder—probably dramatically so." For more information, see the sidebar "Readers Respond" on page 60 of the January/February 2010 issue.

**ERRATA** The article "Daring to Die," by Karen Springen [January/February 2010], incorrectly stated that there is a net under San Francisco's Golden Gate Bridge and that the net prevented suicides. On October 10, 2008, the Golden Gate Bridge Board of Directors voted 14 to 1 to install a net below the bridge as a suicide deterrent, but a net has not yet been installed. "Daring to Die" also incorrectly described Rahil Briggs as a pediatrician. He is a psychologist.

A Head Games puzzle in November/December 2009 incorrectly stated that Thrace is in Greece. Its modern boundaries straddle Greece, Bulgaria and Turkey.

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## >> HORMONES

### Is Estrogen the New Ritalin?

The sex hormone boosts thinking in some women, impairs it in others

Big test coming up? Having trouble concentrating? Try a little estrogen.

Neuroscientists at the University of California, Berkeley, report in a recent study that hormone fluctuations during a woman's menstrual cycle may affect the brain as much as do substances such as caffeine, methamphetamines or the popular attention drug Ritalin.

Scientists have known for decades that working memory (short-term information processing) is dependent on the chemical dopamine. In fact, drugs like Ritalin mimic dopamine to help people concentrate. Researchers have also had evidence that in rats, estrogen seems to trigger a release of dopamine. The new study from Berkeley, however, is the first to show that cognition is tied to estrogen levels in people—explaining why some women have better or worse cognitive abilities at varying points in their menstrual cycles.

The Berkeley team examined 24 healthy women, some of whom had naturally high levels of dopamine and some of whom had low levels, as indicated by genetic testing. As expected, those with the lower levels struggled with complicated working memory tasks, such as repeating a series of five numbers in reverse order. When the test was repeated during ovulation, however, when estrogen levels are highest (usually 10 to 12 days after menstruation), these women fared markedly better,

improving their performance by about 10 percent. Surprisingly, those with naturally high dopamine levels took a nosedive in their ability to do complicated mental tasks at that point in their cycle.

According to Ph.D. student Emily Jacobs, who conducted the study, dopamine in the brain is a "classic Goldilocks scenario." For women with the lowest levels—about 25 percent of the general population—increased dopamine during ovulation will sharpen cognitive functions, whereas for the 25 percent of women with the highest levels, ovulation seems to take them beyond a threshold and to impair thinking. The remaining half of women fall somewhere in between and were not a part of the study.

The work has broad implications. Jacobs says it may mean that caffeine, which triggers a dopamine release, and Ritalin-like drugs are less effective—or even detrimental—at certain times of the month for some women, when estrogen is spiking. More broadly, she hopes to remind scientists studying brain disease that women's and men's brains, though equal in aptitude, are not the same.

"There are pretty important differences," Jacobs says. "And until we figure out how they differ in a normal state, we can't predict how they differ in a diseased state." [For more on sex hormones in the brain, see "Different Shades of Blue," on page 30.] —Erik Vance



AGE FOTOSTOCK (fingers); FROM "SYMBOLIC USE OF MARINE SHELLS AND MINERAL PIGMENTS BY IBERIAN NEANDERTALS," BY JOÃO ZILHÃO ET AL., IN PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES USA, VOL. 107, NO. 3, JANUARY 19, 2010 (shells); JAMES YANG Getty Images (languages in head)



>> IMAGING

## Broken Promises

Brain scans reveal when a vow will not be honored

What goes on in the brain of the groom who says “I do,” then has an affair? Or the friend who pledges to repay a loan but never does? Breaking a promise is a complex neurobiological event, a new study shows—and a brain scan may be able to predict those who are making false promises before they break their word.

Using functional MRI, scientists at the University of Zurich in Switzerland scanned the brains of subjects playing an investment game. Subjects assigned to be “investors” had to decide whether to pledge to share their

money with other players who were “trustees.” This arrangement boosted the amount of money in the pot, but it also could result in a loss to the investor if the trustee chose not to share. Nearly all the subjects said they would give to the trustee—but in the end, not everyone kept this promise.

Based on the fMRI scans, the researchers were able to predict whether the players would break their promise before they actually had the chance to do so in the game. Promise breakers had more activity in certain brain regions, including the prefrontal cortex, an indication that planning and self-control were involved in suppressing an honest response, and the amygdala, perhaps a sign of conflicting and aversive emotions such as guilt and fear.

If the predictive ability of these scans is borne out in future studies, someday the technique could be of use to the justice system. “Brain imaging might be able to help psychologists or psychiatrists decide whether a criminal offender can be released or whether the risk of relapse is too high,” says lead author Thomas Baumgartner, who emphasizes that such scans would supplement assessments by health professionals, not replace them.

—Allison Bond

>> EVOLUTION

## Neandertal Symbolism

Abstract thinking may date back further than previously thought



A metal pin adorning a military uniform signifies rank; a ring on the left hand’s fourth finger announces matrimony. Most scientists thought that the capability for such symbolic thinking was unique to modern humans, but a new study suggests that it dates back to before the Neandertals.

Archaeologist João Zilhão of the University of Bristol in England and his colleagues found 50,000-year-old perforated painted seashells (above) and pigment containers on the Iberian Peninsula in southwestern Europe, a region that was inhabited solely by Neandertals at the time. Modern humans who lived in Africa at that time used similar objects as jewelry and for body painting to symbolize their social standing. The find suggests that the brains of the common ancestor of both species must have already had the biological basis for symbolic thought, meaning its development dates back to about half a million years ago, Zilhão says. He adds that the discovery also implies that the foundation for language was already in place that long ago, because assigning specific meanings to arbitrary words and sounds is “symbolic thinking by definition.”

—Nicole Branan

>> MEMORY

## Once Learned, Never Forgotten

Lost languages acquired during childhood persist in the brain

What happens when a language learned as a child is forgotten over time? Many adoptees and emigrants have no conscious memory of their native tongue, but a new study suggests at least some information remains in the brain. A team from the University of Bristol in England showed that English-speaking adults older than 40 who had spoken Hindi or Zulu as children were able to relearn subtle sound contrasts in these languages, but adults who had never spoken the languages could not—even though the childhood speakers had no explicit memory of the languages. Because memories are neuronal connections that get reinforced with regular access, the finding means that even connections that have not been reaccessed for decades do not disappear completely, as previous evidence had suggested.

—Karen Schrock



## Extinguishing Fear

Erasing frightening memories may be possible during a brief period after recollection



When we learn something, for it to become a memory, the event must be imprinted on our brain, a phenomenon known as consolidation. In turn, every time we retrieve a memory, it can be reconsolidated—that is, more information can be added to it. Now psychologist Liz Phelps of New York University and her team report using this “reconsolidation window” as a drug-free way to erase fearful memories in humans.

Although techniques for overcoming fearful memories have existed for some time, these methods do not erase the initial, fearful memory. Rather they leave participants with two memories—one scary, one not—either of which may be called up when a trigger presents itself. But Phelps’s new experiment, which confirms earlier studies in rats, suggests that when a memory is changed during the

so-called reconsolidation window, the original one is erased.

Using a mild electric shock, Phelps’s team taught 65 participants to fear certain colored squares as they appeared on a screen. Normally, to overcome this type of fear, researchers would show participants the feared squares again without being given a shock, in an effort to create a safe memory of the squares. Phelps’s group did that, but in some cases investigators asked subjects to contemplate their fearful memory for at least 10 minutes before they saw the squares again. These participants actually replaced their old fearful memory with a new, safe memory. When they saw the squares again paired with shocks up to a year later, they were slow to relearn their fear of the squares. In contrast, subjects who created a safe memory of the squares without first contemplating

their fearful memory for 10 minutes immediately reactivated their older, fearful memory when they saw a square and got a shock.

The researchers suspect that after calling up a memory, it takes about 10 minutes before the window of opportunity opens up for the memory to be reconsolidated, or changed, in a meaningful way, Phelps explains. “But there is some combination of spacing and timing that we need to figure out,” she adds—the scientists do not yet know how long the window lasts. Even more intriguing is the role contemplation plays—does sitting and thinking about the fearful memory make it more malleable than does simply recalling it? Although questions remain, Phelps and her colleagues hope their work will eventually help people with debilitating phobias or perhaps even post-traumatic stress disorder. —Molly Webster

>> PLASTICITY

## Brain Makeover

A short therapy session remodels the brains of people with a muscle-control disorder

Practice makes perfect—and it rewires the brain, as many studies have shown. But sometimes hours of practice can take these brain changes too far, as happens in musician's dystonia, when the boundaries between muscles blur in the brain and precise movements are no longer possible. In pianists, for example, the fingers might clutch inward involuntarily every time they attempt to strike a key. This condition takes years to develop, but new research suggests a treatment that takes only 15 minutes can reorganize the brain and allow musicians to play again.

A team led by Karin Rosenkranz of University College London applied vibrations to individual hand muscles in pianists with dystonia, giving each muscle several rounds of a two-second vibration followed by a two-second rest. The 15-minute protocol immediately improved playing to match that of pianists without dystonia.

The team investigated the brain changes underlying the improvement using transcranial magnetic stimulation (TMS), a noninvasive technology that ramps up activity in a precisely targeted area of the brain. The researchers stimulated an area corresponding to one muscle in the hand



as they measured the electrical signals in that muscle to see how these signals changed when they applied vibrations to each of the other hand muscles. In dystonia, activating one muscle accidentally activates other muscles around it, because the brain areas for each muscle are not distinct. After treatment, the researchers confirmed that more distinct boundaries were carved out between the neural territories devoted to each muscle.

Although dystonia may return if old practice habits are resumed, the temporary improvement offered by the new treatment may give sufferers a chance to learn new techniques or change their habits so they can avoid a relapse. "You've got to retrain the brain to manage this [disorder]," says Nancy Byl, a physical therapist at the University of California, San Francisco, who was

not involved in the study. Byl treats dystonia in musicians, athletes, assembly-line workers and people who type intensively, such as software engineers or writers. She notes that overpracticing alone may lead to repetitive strain injury, but it usually takes the addition of anxiety, stress or genetic factors to tilt someone toward dystonia. —Michele Solis

AGE FOTOSTOCK

>> RELATIONSHIPS

## Men Value Sex, Women Value Love?

A new theory about why people get jealous over different kinds of betrayal

Jealousy can be devastating to a relationship—and it is well known that the genders experience the green-eyed monster in different ways. Men are more likely to be jealous of sexual peccadilloes and women of emotional infidelity, according to past research. The oft-quoted evolutionary explanation is that men care more about sex because an unfaithful partner could mean raising someone else's kids, whereas women are protective of emotional attachments because the biggest danger for them is being left alone with the burden of single parenthood. But a new study from Pennsylvania State University suggests it may be time to rethink why the genders re-

spond differently to each indiscretion.

In a study of more than 400 people, clinical psychologists Kenneth Levy and Kristen Kelly found that individual personality differences—which stem from a person's childhood experiences—explain the genders' jealousy patterns. The pair asked subjects what would be more upsetting: their partner having sex with someone else or forming a strong emotional bond with another person. Both men and women with a kind of insecure attachment called dismissing—typical of people who had inconsistent or insensitive parents and learned to shun intimacy and become "hyperindependent"—were the most likely to report being



jealous of sexual infidelity. More men than women have a dismissing attachment style. The reason for this gender difference is unclear but may relate, in part, to cultural notions of what constitutes "manly" behavior. Levy says this understanding of personality formation, known as the attachment model, seems to explain both the average differences between men and women in what makes them most jealous, as well as the previously unexplained fact that a subset of individuals better fits the jealousy profile of the opposite sex. —Andrea Anderson

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>> NEUROSCIENCE

## Going Out with a Bang

The brain surges with activity just before death

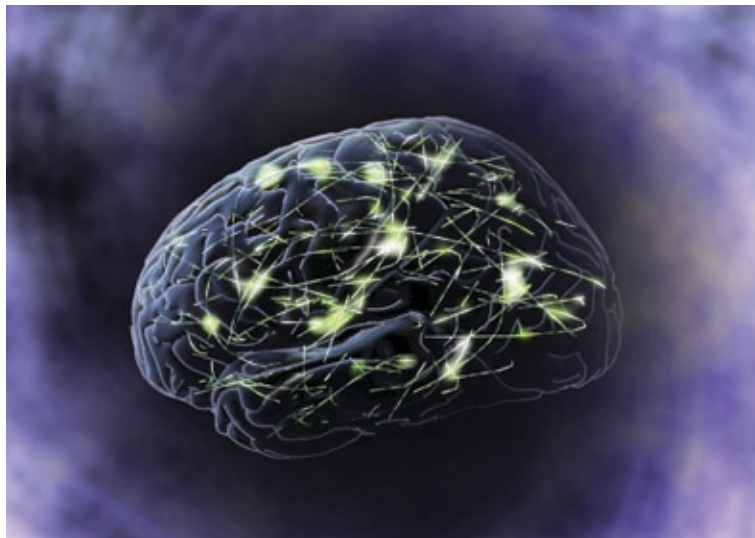
People who are resuscitated from near death often report strange sensory phenomena, such as memories “flashing before their eyes.” Now a rare assessment of brain activity just before death offers clues about why such experiences occur.

Anesthesiologist Lakhmir Chawla of George Washington University Medical Center and his colleagues recently published a retrospective analysis of brain activity in seven sedated, critically ill patients as they were removed from life support. Using EEG recordings of neural electrical activity, Chawla found a brief but significant spike at or near the time of death—despite a preceding loss of blood pressure and associated drop in brain activity.

“To our knowledge, this is the first time that this event has been shown to occur,” Chawla explains. “It occurs at a very peculiar time point, when most people would think your brain would physiologically die [because of] an absence of blood flow.”

The jolts lasted 30 to 180 seconds and displayed properties that are normally associated with consciousness, such as extremely fast electrical oscillations known as gamma waves. Soon after the activity abated, the patients were pronounced dead.

Chawla posits that the predeath spikes are most likely brief, “last hurrah” seizures originating in brain areas that were irritable from oxygen starvation. Living nerve cells constantly maintain an electrical charge gradient, similar to the difference in charge on the poles of a battery. Keeping up this polarity takes energy—in this case, energy created from



oxygen. As blood flow slows and oxygen runs out, the cells can no longer maintain polarity and they fire, causing a cascade of activity that ripples through the brain. If these seizures were to occur in memory regions, they could explain the vivid recollections often reported by people who are resuscitated from near death, Chawla says.

Further speculation is difficult because in these patients only the forebrain was monitored, notes Chawla, adding that the end of life is a poorly researched area. Next he and his colleagues would like to use more sophisticated imaging on a larger patient population to assess the entire brain in greater detail during near-death episodes. —Peter Sergio

EQUINOX GRAPHICS Photo Researchers, Inc.



>> MIND/BODY

## Stop Slouching!

Good posture boosts self-esteem

When you were growing up, your mother probably told you to sit up straight, because good posture helps you look confident and make a good impression. And now it turns out that sitting up straight can also improve how you feel about yourself, according to a study in the October 2009 issue of the *European Journal of Social Psychology*. Researchers asked college students to rate themselves on how good they would be as job candidates and employees. Those told to sit up straight with their chests out gave themselves higher ratings than those instructed to slouch while filling out the rating form. Once again, Mom was right. —Harvey Black

BETSIE VAN DER MEER Getty Images

## Could Cell Phone Radiation Protect Memory?

Exposure to waves like those from phones prevented Alzheimer's disease in mice

After spending years fighting claims that cell phone use can cause brain tumors, industry reps may be getting some welcome news. A new study suggests cell phone radiation may actually have a beneficial biological effect—two hours of exposure a day staved off Alzheimer's disease in mice.

Scientists at the University of South Florida studied mice that are genetically predisposed to develop Alzheimer's and its accompanying memory problems. Based on previous research, the researchers hypothesized that radiation from phones would accelerate progression of the disease because other types of radiation cause free radical damage. The team used an antenna to expose some of the mice to electromagnetic waves that approximated two hours of daily cell phone use. To the scientists' surprise, the mice that were dosed with cell phone radiation did *not* suffer from memory impairments as they aged—unlike their radiation-free counterparts. The mice exposed to phone waves retained their youthful ability to navigate a once familiar maze after time spent in different mazes.

The researchers hypothesize that the radiation prevented the buildup of amyloid plaques, the sticky protein aggregates that are found in Alzheimer's brains. They suggest that their work may eventually lead to a treatment that can halt the disease process.

Studies in mice are preliminary, of course: many avenues of treatment that seem promising in rodents fail to pan out in humans. But the new paper raises questions about the cell phone industry's claim that its products' emissions are too weak to have any biological effects. Although the link to brain tumors remains inconclusive, the new work suggests cell phones may indeed be messing with our minds.

—Allison Bond



IMAGES.COM/CORBIS

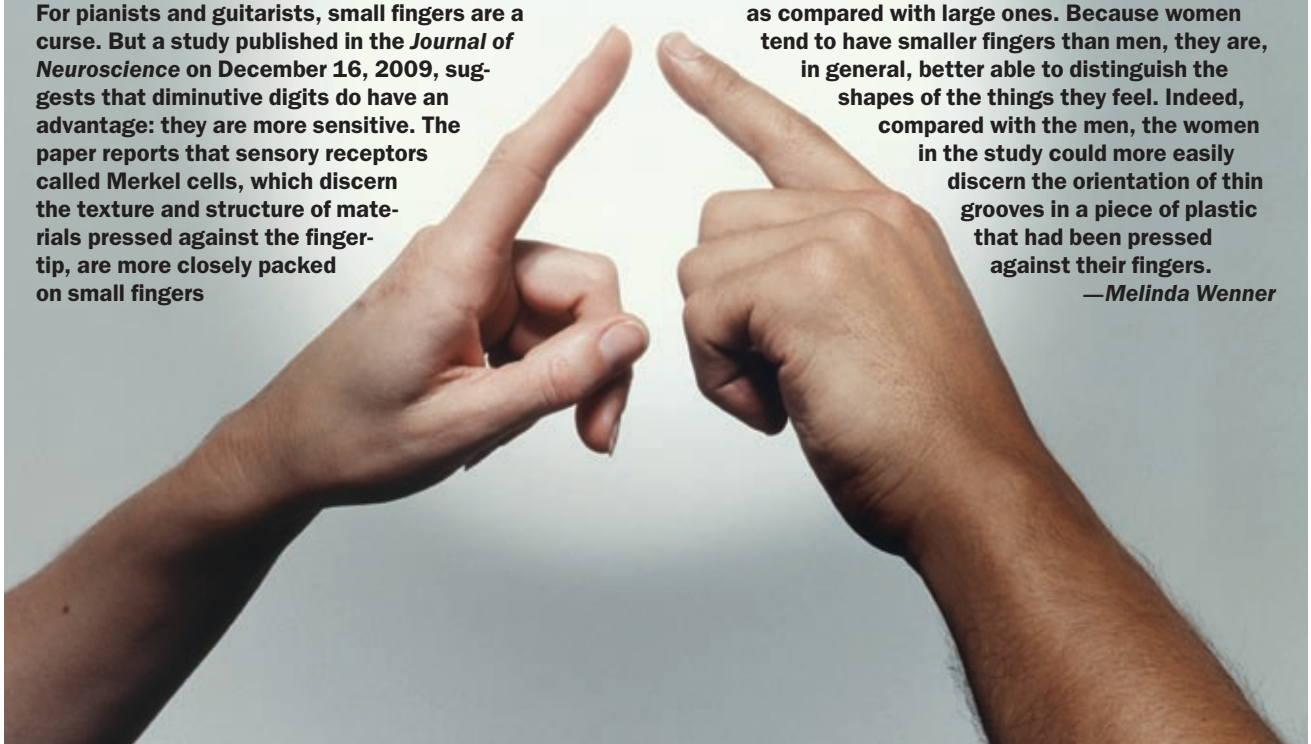
## Women's Better Sense of Touch Explained

Smaller fingers mean closer nerve endings and the ability to resolve finer detail

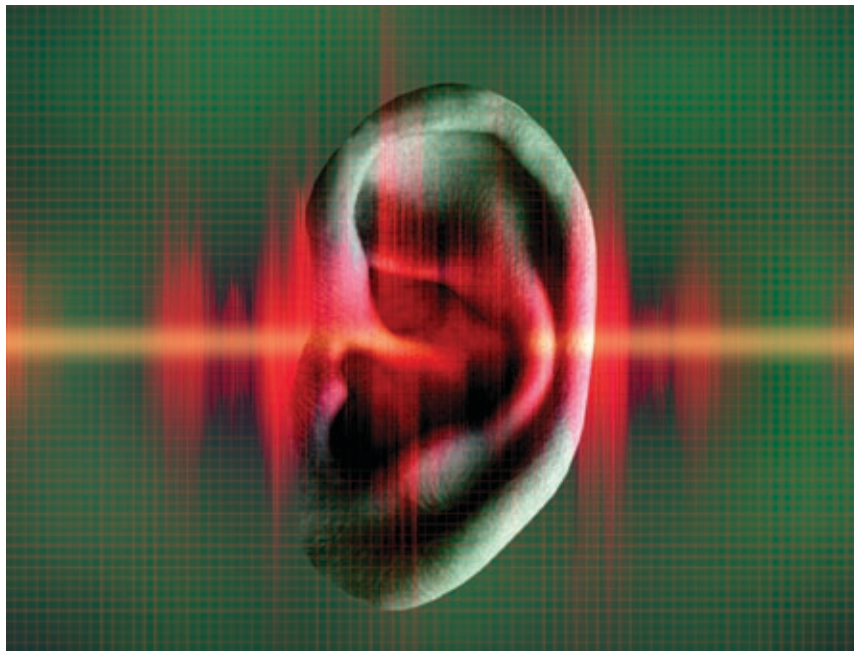
For pianists and guitarists, small fingers are a curse. But a study published in the *Journal of Neuroscience* on December 16, 2009, suggests that diminutive digits do have an advantage: they are more sensitive. The paper reports that sensory receptors called Merkel cells, which discern the texture and structure of materials pressed against the fingertip, are more closely packed on small fingers

as compared with large ones. Because women tend to have smaller fingers than men, they are, in general, better able to distinguish the shapes of the things they feel. Indeed, compared with the men, the women in the study could more easily discern the orientation of thin grooves in a piece of plastic that had been pressed against their fingers.

—Melinda Wenner



SHUJI KOBAYASHI Getty Images



>> AGING

## Preventing Hearing Loss

Scientists discover why we get deafer with age—and how antioxidants might slow the process

Old age brings with it a host of physical woes, and among the most common is hearing loss. Forty percent of Americans older than 65 suffer from hearing loss, and by 2030 some 65 million Americans will be hard of hearing.

Now joint work by researchers at the universities of Wisconsin, Florida, Washington and Tokyo has uncovered the mechanism behind age-related hearing loss, and with the help of simple chemicals, they have managed to keep old mice hearing as well as young pups.

The team investigated a molecular mechanism that has been implicated in many age-related maladies but had not yet been tied to hearing loss. Our bodies are constantly exposed to short-lived organic molecules known as free radicals, which harm cells in a process called oxidation. When cells are stressed by oxidative damage, they release a protein called Bak, which triggers a cascade of events culminating in cell suicide.

To test whether this mechanism was responsible for age-related hearing loss, the researchers compared normal mice with genetically engineered mice that do not have the gene necessary to make Bak. These Bak-deficient mice failed to develop hearing problems as they aged, but the ordinary mice, subjected to the same oxidative stress, became hard of hearing. Although most cells in the body are replaced with new cells after they die, the inner ear's sensory nerve cells and ganglion neurons do not regenerate, so hearing loss is permanent.

After determining the cause of hearing loss, the researchers combed through published literature to see what kind of intervention might stave off free radical damage. Two antioxidants—molecules that prevent free radicals from harming cells—stood out: alpha lipoic acid (found in organ meats) and coenzyme Q10 (abundant in meat, fish and poultry). “When we fed [normal] mice these antioxidants in their food, they were protected from free radical damage in the cochlea,” says the study’s first author, Shinichi Someya of the University of Wisconsin–Madison. The team focused exclusively on the inner ear in its studies, but Someya says other body systems might also benefit from the antioxidants.

—Sandy Fritz

>> EATING

## Men Suppress Food Cravings Better Than Women

Guys can lower their brain activity in hunger regions on command

Worldwide, women suffer higher rates of eating disorders and obesity than men do—and a recent study may help explain why. Gene-Jack Wang of Brookhaven National Laboratory used PET scans to look at brain activity in fasting men and women as they were exposed to the sight, smell and taste of their favorite food. Some subjects of each gender were then told to try to ignore their craving for the food.



In men, this willful inhibition directly affected brain metabolism—the group suppressing their craving had less activation in the limbic and paralimbic regions, which control awareness of hunger and desire for food. The two groups of women, in contrast, had equivalent brain activity. This observation corresponds to the participants’ experience: the men who tried to ignore their craving felt a decreased desire for the food, but the women were tantalized despite their efforts at self-control. Wang also reported that the women’s brains showed a much greater response to their favorite food than men’s did, and he speculates that these findings may help explain why so many women struggle with their weight.

—Diane Welland

MIKE AGLIOLO Photo Researchers, Inc. (ear); JUPITERIMAGES (man and woman)

>> GENETICS

## The Clock Is Off

Bipolar disorder may be linked to mutations affecting circadian rhythm

An off-kilter body clock can throw off our sleep-wake cycle, eating habits, body temperature and hormones—and mounting evidence suggests a malfunctioning clock may also underlie the mood cycles in bipolar disorder.

In a new study led by psychiatrist Alexander Niculescu of Indiana University, researchers found that children with bipolar disorder were likely to have a mutated *RORB* gene, which codes for a protein crucial to circadian clock function. The team's previous work identified alterations to this gene and other clock genes in animal models of the disorder. In the new study, the scientists compared the genomes of 152 bipolar kids with those of 140 typical kids. (Children were studied because their moods cycle more rapidly than the moods of bipolar adults, and a quicker cycle suggests a stronger connection to the circadian clock.) The team found that the bipolar children were more likely to have one of four alterations to *RORB*, and the investigators suspect the mutations prevent the body from producing the correct amount of the protein to support normal clock function.

Previous studies had shown that strictly regulating a bipolar patient's sleep schedule could improve extreme mood cycles, but experts weren't sure why—until animal studies started showing a connection to circadian clock genes.

"Every time we investigate some [abnormality] of molecular machinery linked to the clock genes, we find an association with bipolar disorder," says Francesco Benedetti, a neuroscientist at the San Raffaele Scientific Institute in



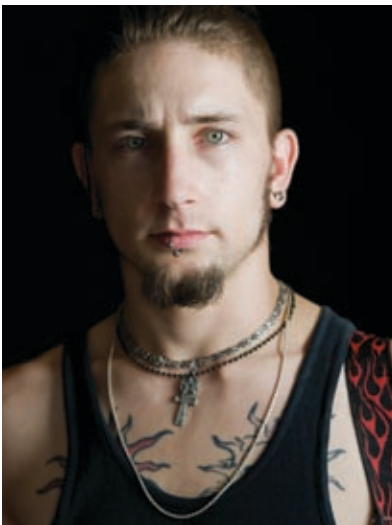
Bipolar kids may have a gene variant that affects their sleep cycle.

Milan, Italy, who was not involved in the Indiana research. The ultimate goal, he adds, is to pinpoint the precise mechanism that links clock function with mood swings, in the hope of designing new drugs and treatments that will restore the clock to working order. —Monica Heger

>> NATURAL SELECTION

## Survival of the Tattooed and Pierced?

Body art may be evidence of high-quality genes in men



When surveyed, most people say they get tattoos or unconventional piercings to express individuality. But could something more psychologically primal be afoot? Researchers at the University of Wroclaw in Poland measured about 200 men and women—half of them inked or pierced in places other than their earlobes—for body symmetry, or how similar their right and left sides are. (More similarity indicates genetic health and is associated with sexual attractiveness.)

Among the research subjects, men with bodily decorations exhibited greater symmetry than those without, whereas no differences emerged in women. Because people who are less symmetric did not opt more often for tattoos and piercings, researchers rejected one widely held hypothesis that suggested people use physical graffiti to hide or distract from imperfections in their appearance.

The results jibe with a different theory—getting stuck with needles can endanger one's health via infections, so the study supports the evolutionary "handicap" theory that only those with high biological quality can afford such risky behavior. The impulse to get inked may be a risk-taking behavior inherited from ancestors who were strong enough to endure injuries and survive—as opposed to those whose ancestors survived by avoiding risk and injury. Therefore, at least in men, body art could serve as an "honest" signal of fitness in the Darwinian sense. So maybe that's why pierced, tattooed rock stars do so well with the ladies. —Adam Hadzazy

# She's Hooked

The allure of alcohol, drugs and cigarettes ebbs and flows with a woman's monthly cycle

BY EMILY ANTHES

**ADDICTION** has long been considered a man's disease. Men are far more likely to use illicit substances, and partly for that reason, research on addiction for decades included only male users. Thus, far more is known about drug dependence in men than in women, and treatment programs and centers have been based on the needs of men.

But there are signs that the gender gap is closing, as drug and alcohol use have become more socially acceptable for girls and women. Indeed, drinking and alcohol dependence have grown increasingly prevalent among women in recent decades, but not among men, reported psychiatrist Richard A. Grucza of Washington University in St. Louis in a 2008 study.

And in a reversal of past trends, teenage girls are now trying marijuana, alcohol and cigarettes at higher rates than boys are, according to recent results from the National Survey on Drug Use and Health. Meanwhile the survey demonstrated that overall illegal drug use among both girls and women rose from 5.8 to 6.3 percent between 2007 and 2008 as the rate for boys and men dipped from 10.4 to 9.9 percent.

What is more, a growing literature on female addicts shows that they are not much like their male counterparts. Women may be uniquely vulnerable to substance abuse and its effects, because



Women seem particularly susceptible to addiction: they quickly become heavy users and suffer greater harm from drug use than men do.

female sex hormones affect the brain's reward circuitry, influencing women's response to drugs. The studies point to new drug treatments for addiction as well as practical tips for women who want to quit using.

## The Weaker Sex?

Although scientists have been studying drug use in women on a small scale since the 1970s, progress was relatively

meager before 1994, when the National Institutes of Health mandated that most clinical research include women and minorities. As research on gender differences greatly accelerated, investigators uncovered hints that girls and women may be more vulnerable to addiction and substance abuse than men are. Scientists noticed that women more quickly escalate to heavy drug use and more readily succumb to the accompanying social and physical damage. Even female rats obsessively self-administer addictive drugs more readily than male rodents do.

Reproductive hormones may underlie this susceptibility. Removing the ovaries of female rats so that the animals no longer produce estrogen can diminish their tendency to seek out stimulants such as cocaine and amphetamine. In addition, giving estrogen to female rats whose ovaries have been removed can shorten the path to addiction. In 2004 neuroscientist Jill B.

Becker of the University of Michigan at Ann Arbor and her colleagues reported that it took six days for ovary-free rats to start repeatedly helping themselves to infusions of cocaine—in this setup, by poking their noses into a hole. In contrast, rats receiving supplemental estrogen succumbed to the same compulsion after just four days.

Researchers believe that estrogen spurs addiction by stimulating the

PIOTR POWIETRZYNSKI/Getty Images



Scientists believe that **estrogen stimulates** the brain's reward pathways, enhancing the "high" from drugs.

brain's reward pathways, enhancing the "high" from drugs. Administering estrogen to rats that have had their ovaries removed boosts levels of dopamine, a neurotransmitter involved in the perception of rewards such as food, sex and drugs.

### Hormone High

In female mammals, estrogen does not act alone, however. Its hormonal partner, progesterone, appears to oppose estrogen's ability to promote addictive tendencies. In 2006 Becker's team reported that giving both estrogen and progesterone to female rats lacking ovaries does not accelerate obsessive cocaine use in the rodents, suggesting that progesterone may be an antidote to estrogen's pleasure-seeking influence.

And more recent work confirms that women's response to drugs varies across the menstrual cycle, as the relative levels of estrogen and progesterone naturally wax and wane. In a 2007 study clinical neurobiologist Suzette M. Evans of Columbia University and the New York State Psychiatric Institute and her colleagues found that stimulants are far more pleasurable to women during the estrogen-dominated follicular phase, which occupies the approximately two weeks from the onset of a woman's period until she ovulates, than during the luteal phase after ovulation, when both estrogen and progesterone are high.

A woman's perception of other kinds of rewards—such as money, food and sex—may also vary during her menstrual cycle. In a 2007 study researchers at the NIH scanned women's brains using functional MRI as the women played slot-machine games. They found that women's reward circuitry was more active when they won jackpots during the estrogen-governed phase of their cycles than during the progesterone-infused phase that follows. The ebb and flow of female hormones could thus have broad

Women are more likely to succeed in quitting smoking if they start on a day when their natural progesterone levels are high.

effects on the perception of pleasures and incentives, influencing women's motivation to engage in a wide variety of behaviors.

### A Smarter Way to Stop

Artificially boosting progesterone levels in women tempers the "high" they get from drugs. In a 2006 study Evans's team gave 11 female cocaine users progesterone when their bodies' natural levels of the hormone were low. The treated women reported feeling a reduced high as compared with the one they got at the same point in their cycles in the absence of additional progesterone. (In contrast, progesterone did not influence the subjective experience of cocaine smoking in the 10 male addicts they tested, although the researchers are not sure why.) If progesterone dampens the pleasure of drugs, it might help treat addiction in women—something Evans is currently testing in female cocaine addicts.

Short of a chemical fix, paying attention to the calendar could help women succeed at quitting smoking, drinking or using drugs. In a study published in 2008 Sharon S. Allen, a family medicine doctor at the University of Minnesota Medical School, and her colleagues asked half of 202 female smokers to try to quit



during the second part of their cycles—when progesterone levels are high—and the others to make the attempt earlier in their cycles. The results were stunning: 34 percent of the women in the first group had not smoked 30 days later as compared with only 14 percent of those who tried to stop smoking when progesterone levels were low. "When women are smoking early in their cycle, they're getting more of a kick from their nicotine, more pleasure maybe, so it might be harder to quit," Allen explains. In this mix of hormones, brain chemicals and desire—as in many other parts of life—timing may be everything. **M**

EMILY ANTHES is a freelance science and health writer living in Brooklyn, N.Y. Her work has appeared in *Scientific American Mind*, *Discover*, *Popular Mechanics*, *Slate*, *New York Magazine* and the *Boston Globe*, among other publications.

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# Regaining the Rainbow

Genetic intervention cures color blindness in monkeys

BY CHRISTOF KOCH



THERE IS AMPLE EVIDENCE that men and women think, express themselves and even experience emotions differently (for more details, read on through this issue). But in the area of sensory perception, psychologists are hard-pressed to identify major discrepancies. By and large, the way the two genders experience the sounds, sights and smells of life is quite similar. The most striking exception may be found, at least for some, in the perception of colors.

Seeing in color is a complex process, as you may remember from your school days. It starts with the delicate lining of the eyes, a structure called the retina. Retinal tissue contains light-sensitive cells that absorb wavelengths in the visible spectrum and convert them into electrical signals. The brain interprets this information as the riot of colors we consciously experience. The retinal cells called cones come in three varieties. The S-type cone is maximally sensitive to light in the short-wavelength (blue) part of the visible spectrum, the M-type cone responds best to medium wavelengths, and the L-type to long, reddish wavelengths. People with normal color vision are known as trichromats because they possess these three kinds of photosensitive cone cells.

About 8 percent of men, but fewer than 1 percent of women, have impoverished color vision, typically because they lack the gene for either the L- or the M-type photopigment. While their vision is normal in every other way, they suffer from what is often called red-green color blindness. Depending on the specific genetic omission involved, such people—who are known as dichromats because they have only two types of cone cells—are unable to distinguish between violet, lavender and purple or between red, orange, yellow and green.

It's not a tremendous handicap, but it can make traffic lights—especially hori-



Men are more often color-blind because two genes that enable the eye to absorb light sit on the X chromosome. Men have only one X; women have a backup.

zontal ones—as well as warning lights that flash either yellow or red hard to decode. And a lack of sensitivity to reddish hues makes it almost impossible for a dichromat to detect the onset of sunburn. (The photographs on the opposite page show the sickly-looking hue of skin as seen through color-blind eyes.)

The reason color blindness is so much more common in boys and men is that the two genes for the L- and M-type photopigments—the substances in cone cells that absorb light—are carried on the X chromosome. A girl who inherits one defective copy of such a gene from her parents has a backup on her other X chromosome. Because men have only one X chromosome (their paired sex chromosome is a Y), they lose out. Interestingly, also thanks to the vagaries of genetics, some women are endowed with four kinds of photosensitive cones instead of the standard three. Theoretically, these so-called tetrachromats can identify subtleties of shading that are indistinguishable to the

rest of us; however, this phenomenon has been hard to confirm experimentally.

## Color Correction

Unlike humans, most mammals possess just two kinds of retinal cones. Thus, mice, cats and dogs see the world much the way a red-green color-blind person does, making them ideal experimental subjects. A few years ago scientists at the Johns Hopkins School of Medicine inserted the gene for the human L-type photopigment into mice. After several generations of breeding, the mice responded to the extra hue information. They had changed from dichromats to trichromats—a remarkable feat of bioengineering. The experiment also showed that mouse brains are flexible enough to receive and make use of the additional wavelength information.

An even more ambitious experiment, extending over a decade, came recently to fruition. It was conducted by the husband-and-wife team of Jay Neitz and Maureen Neitz, both professors at the

CHRISTOF KOCH (Koch); OLEKSIY MAKSYMENKO All Canada Photos/Corbis (rainbow eye)

We could potentially **extend human vision** into the ultraviolet or infrared: the superhero spectrum.

University of Washington School of Medicine, and their collaborators. The work involved squirrel monkeys, a species indigenous to Central and South America. Among these primates, most females are trichromats, but the males are dichromats, possessing only the S-

treated monkeys, like the mice from the earlier experiment, did indeed discriminate among colors.

The monkeys' new color awareness emerged as soon as the photopigments were expressed in their retinas. The lack of delay suggests that preexisting retinal

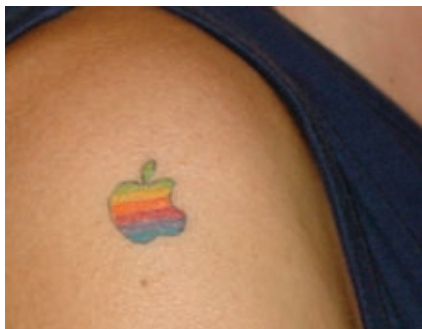
animals show increased processing in the regions of visual cortex dedicated to color perception. I would bet 100 to one that they do.

The virus used in this experiment is safe—it doesn't replicate by itself, doesn't cause disease and triggers only a mild immune response—and it has been approved for gene therapy in humans. So this technique could be adapted to help color-blind people see normally. The condition affects many millions in the U.S. alone. Provided that the risk-to-benefit ratio of gene therapy can be improved significantly, a potential cure could have a dramatic impact on the sensibilities of a large slice of humankind.

Jay Neitz believes that this operation will someday become as safe as refractive surgery such as Lasek. Methods such as the one the Neitzes have pioneered, as well as the optogenetic techniques discussed in my last column [see "Playing the Body Electric," March/April 2010] may well, soon enough, make the (color)-blind see again.

Of course, there is little reason to stop there. Why not enhance visual experience to give the more adventuresome among us tetrachromacy? Or extend the window of visibility up into the ultraviolet or down into the infrared for superherolike vision? Thanks to cutting-edge molecular biology, we can see our way into a transhuman future. **M**

CHRISTOF KOCH is Lois and Victor Troendle Professor of Cognitive and Behavioral Biology at the California Institute of Technology. He serves on *Scientific American Mind's* board of advisers.



Two views of the author's right deltoid: A regular one (left), and a manipulated one (right) that suggests how it would look to a color-blind person who doesn't see reddish wavelengths.

and M-type photopigments. Accordingly, it is the females that lead troops of monkeys to search for ripe fruits among the foliage, a quest that requires superior color discrimination skills.

The Neitzes wondered: Could gene therapy "cure" the male monkeys' color blindness? To find out, the biologists developed a way to incorporate the gene for the human L-type photopigment into a small virus known as adeno-associated virus. Next they injected tens of trillions of viral particles into the monkeys' eyes. Twenty weeks later up to one third of the M-type cones in the animals' retinas had begun to express the L-type photopigment. In other words, the monkeys now had not two but three cone types: in addition to their original S-type and M-type cones, they had new M-type cones whose sensitivity had shifted toward the long-wavelength part of the spectrum.

The million-dollar question was whether the rest of the animals' central nervous system could reprogram itself to make use of this additional information. Using a computer-administered color test, the Neitzes demonstrated that the

and cortical circuitry can incorporate the additional information; no time-consuming rewiring was necessary. It also suggests how the evolutionary transition from two- to three-cone color vision might have come about.

### From Monkeys to People

Two years after the Neitzes' experiment their monkeys' color vision remains transformed. Being the careful scientists they are, they do not take a stand on whether or not the monkeys see novel reddish hues. Yet I find no principled reason to deny it. The retinal machinery for trichromacy is present, and the monkeys' behavior indicates that they experience these hues. Within a few years electrophysiological and functional imaging experiments will inform us whether the an-

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CHRISTOF KOCH

# Hey, Is That Me over There?

And other real-life tales from the bizarre realm of out-of-body experience

BY VILAYANUR S. RAMACHANDRAN AND DIANE ROGERS-RAMACHANDRAN

IF THERE IS ANYTHING about your “self” of which you can be sure, it is that it is anchored in your own body and yours alone. The person you experience as “you” is here and now and nowhere else.

But even this axiomatic foundation of your existence can be called into question under certain circumstances. Your sense of inhabiting your body, it turns out, is just as tenuous an internal construct as any of your other perceptions—and just as vulnerable to illusion and distortion. Even your sense of “owning” your own arm is not fundamentally different—in evolutionary and neurological terms—from owning your car (if you are Californian) or your shotgun (if you are Sarah Palin).

Outlandish as such a notion may seem, what you think of as your self is not the monolithic entity that you—and it—believe it to be. In fact, it is possible to pharmacologically manipulate body ownership with a drug called ketamine, which reliably generates out-of-body experiences in normal people. Patients on ketamine report the sensation of hovering above their body and watching it. If someone gives them a sharp poke, they might say, “My body down below is feeling the pain, but I don’t feel it myself.” Because in such patients the “I” is dissociated from the body it inhabits, they do not experience any agony or emotional distress (for this reason, ketamine is sometimes used as an anesthetic).

Your sense of body ownership, and of being a distinct entity, seems to derive in part from a network of brain cells known as mirror neurons. Located in the premotor cortex, they interact with your prefrontal cortex, the part of the brain that makes plans and decisions. Ordinarily, when you move your hand to, say, reach for a pen (a motion that is accompanied by your sense of having free will), certain motor-command neu-



**Out-of-body experiences are not imaginary. Doctors can generate them by giving patients the drug ketamine.**

rons in the motor cortex fire. Intriguingly, as Giacomo Rizzolatti of the University of Parma in Italy and his colleagues Marco Iacoboni and Vittorio Gallese have demonstrated, some of these neurons also fire when you merely *watch* another person perform the same action.

Mirror neurons allow you to put yourself in another person’s shoes. Your brain says, in effect, “The same neurons are firing as when I move my hand, so I know what he is feeling and what he is up to.” In addition, neurons we might loose-

ly call “touch mirror neurons” fire when you are touched or watch someone else being touched. That humans have these abilities made intuitive sense to Charles Darwin, who noted that when you watch a javelin thrower about to release the spear, your leg muscles flinch unconsciously and that when a child watches his mother use a pair of scissors, he clenches and unclenches his jaws in uncontrollable mimicry. In this phenomenon we see an evolutionary prelude to the ability to imitate and emulate—the basis

GETTY IMAGES

of cultural transmission of knowledge.

Yet as you grow to adulthood, you no longer irresistibly mime the actions of whomever you happen to be looking at; your self doesn't feel like a puppet controlled by others. You preserve your sense of free will and agency (although patients with Tourette syndrome do sometimes engage in unconscious mimicry).

The tendency to unconsciously mimic the person you are with is normally inhibited by your prefrontal cortex (the most evolutionarily advanced part of the brain, which is pronounced in humans). We recently suggested in an essay on the

pressions, and you will get the impression that the creature is mimicking your contortions in perfect synchrony. The experience should give you a momentary sense of decapitation—an inkling of what it must feel like to take ketamine.

The illusion will be enhanced if you place two panes of glass at right angles. Shift your head until the reflection of the center of your nose is exactly on the corner of the two panes (and superimposed on the mask behind). If you now wink your right eye, the reflection will wink *its* right eye (the double reflection violates an ordinary reflection's left-right rever-

ing at (without using optics to help you identify with it), you would not flinch. It's the sense of merging with the "other head" that does it.

More recently, scientists have used video cameras to produce similar "disembodiment" illusions, in which people feel they are projecting their body to some outside location. These spooky experiences are of the kind that might occur after, say, a stroke damaged the right parietal lobe. This is the area of the brain that seems to be partly responsible for creating body image, a sense of inhabiting one's own form.

( Even *real* pain in a real arm can be cured through carefully engineered **optical illusions.** )

Edge Foundation Web site ([www.edge.org](http://www.edge.org)) that interactions between the mirror neuron system and feedback from the prefrontal cortex is what gives the self its peculiar dual character of simultaneously maintaining individuality and reciprocity with others.

Derangements in this system would lead to out-of-body experiences, which may explain the mechanism of ketamine. Under its influence you "empathize" with your body the same way you empathize with other people, and you are able to simultaneously detach yourself from it—just as you detach yourself from others.

### Parlor Tricks to Lose Yourself In

You don't need ketamine to produce such dissociations, however; if you have the money, you can do it with immersive virtual-reality technology. For the rest of us there are some simple optical tricks.

For example, try looking at a Halloween mask through a shiny pane of glass, so that you see a reflection of your face superimposed on the mask. By changing the relative illumination of the mask and your face, you can optically blend the two to produce a strange hybrid creature. Now make odd facial ex-



**Staring at a mask and your reflection simultaneously can conjure a sensation of headlessness.**

pression). The result is an even more compelling illusion that you occupy the mask.

If you go to the next level—which involves a combination of lighting, makeup, mannequins and a hall-of-mirrors effect created when you stand between two body-length mirrors that face one another, producing an endless number of optical clones of yourself—you start to approximate the effects of ketamine. In the mid-1990s we showed (with William Hirstein and Eric L. Altschuler of the University of California, San Diego) that punching the mask under these conditions produces instant fright. We measured subjects' fear objectively by monitoring changes in their skin resistance—that is, how much they sweated. If I threatened any old mask you were look-

ing at, he also felt the twin being touched a few seconds later. Stimulating the vestibular canals in the patient's inner ear made him feel like he was twirling around and caused the phantom to shrink and shift. (The vestibular system, which contributes to balance and spatial orientation, connects to the right parietal lobe.)

The great English neurologist Macdonald Critchley described many other patients who—depending on the parts of the parietal lobe involved—felt like giants or pygmies; experienced their body parts as distorted or swollen; disowned an arm, claiming it belonged to their mother; or even hated a particular limb—claiming, for example, that "my hand is a communist." We suggest that the sense of "ownership" of even external objects

of "ownership" of even external objects

(wedding rings, tennis rackets) that is so ubiquitous in our species (Gandhi being a notable exception) may have exapted—in other words, developed as a secondary use—from neural systems that originally evolved for body ownership.

**The Mirror Cure**

We mentioned earlier that one reason you do not mimic someone or literally feel another’s touch sensations when you watch her being touched is that your prefrontal cortex inhibits your mirror neuron output. A second reason may be that when you watch someone else being touched, even though your touch mirror neurons are active, your skin receptors report the fact that they are not being touched, and this null signal prevents the mirror neuron activity from reaching the threshold of conscious experience.

But guess what would happen if someone were to numb your hand using an anesthetic? Astonishingly, we have found (in collaboration with U.C.S.D. graduate student Laura Case) that the patient now quite literally feels touch sensations in his anesthetized hand when he merely watches another person being poked. Or if the other person handles an ice cube, the patient feels the cold freezing his hand! Once you remove the touch signals from the intact hand, the patient does not merely empathize with others—he feels what they touch. The same thing happens in patients with phantom limbs. Watching another person’s hand being massaged seems to relieve pain in the patient’s absent arm or leg.

Clinically it is known that visual feedback using mirror reflections can help alleviate phantom pain and stroke paralysis, perhaps by tapping into mirror neurons. We are currently exploring whether illusions of disembodiment produced with mirrors can also be used to mimic the effects of ketamine and treat chronic pain syndromes by allowing a patient to “detach” from his body and the pain “it” experiences.

Extraordinarily, even *real* pain in a real arm can be cured through optical feedback. In particular, there is a cruel disorder called reflex sympathetic dystro-



**Damage to the right parietal lobe can make people feel like giants or pygmies.**

phy in which a trifling injury leads to permanent excruciating pain, swelling and “paralysis” of an arm, a condition we have dubbed “learned pain and paralysis.” In 1995, in a lecture at the Society for Neuroscience meeting in San Diego, we suggested using mirrors to treat this disorder, and several large-scale clinical trials have since confirmed their efficacy. Even the swelling subsides—a remarkable example of mind-body interaction.

The strangest of body-image disturbances is one in which a perfectly healthy person desires to have an arm or leg amputated. In conjunction with our U.C.S.D colleagues David Brang and Paul McGeech, we have found that touching the skin of the affected limb produces an abnormal sweating response, whereas touching the normal limb does not. Fur-

ther, our brain-imaging studies indicate an impoverished representation of the affected limb in the right parietal lobe (the body image area), although the areas for touch in the somatosensory cortex remain normal. This discrepancy between accurate sensory input from the arm and a lack of arm representation in the brain creates a curious abhorrence of the limb [see “Amputee Envy,” by Sabine Mueller; *SCIENTIFIC AMERICAN MIND*, December 2007/January 2008].

Thus, studying people with brain abnormalities or manipulating sensory input in normal people using mirrors and other optical tricks can provide key insights into the way the right parietal lobe of the brain creates a vibrant image of one’s body that endures in space and time.

These observations have important implications, both theoretical and clinical. They suggest that what we call touch sensation, pain, the body or even the self results from a dynamic interplay of signals from three sources: sensory signals from the skin, muscles and gut; inhibitory signals from the prefrontal cortex; and input from mirror neurons, which respond to behavior that originates in neurons in *other* people’s brains! From this fluctuating mosaic of brain activity emerges your sense of an embodied self that is distinct from others and all your own. **M**

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**(Further Reading)**

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- ◆ **Grasping the Intentions of Others with One’s Own Mirror Neuron System.** M. Iacoboni, I. Molnar-Szakacs, V. Gallese, G. Buccino, J. C. Mazziotta and G. Rizzolatti in *PLoS Biology*, Vol. 3, No. 3, page e79; 2005.
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- ◆ **The Use of Visual Feedback, in Particular Mirror Visual Feedback, in Restoring Brain Function.** V. S. Ramachandran and E. L. Altschuler in *Brain*, Vol. 132, No. 7, pages 1693–1710; 2009.

SHUJI KOBAYASHI/Getty Images

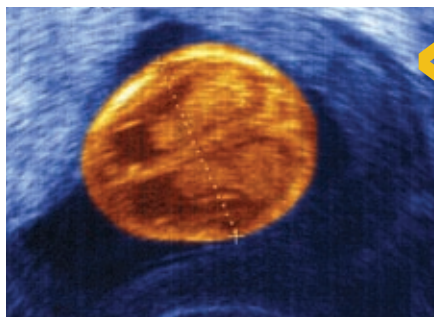
# (calendar)

## May



**5** German philosopher **Karl Marx** was born on this day in 1818. Although Marx is most famous for his political ideas, his philosophies also contributed indirectly to modern psychology. Embedded

in Marx's doctrine of historical materialism—the study of society, economics and history—is the idea that understanding the human mind relies not only on inward reflection but also on the historical and social context in which a person lives. For Marx, that meant a person's work life. Today the study of social psychology explores in much greater depth how cultural influences, social status and other factors contribute to a person's mind-set and behaviors.



The brain of a three-month-old fetus, from an ultrasound image (colorized for clarity).

**11** Could working with animals help autistic children learn to speak? Although the scientific evidence for animal therapy is still controversial, anecdotes suggest that for some kids, four-legged friends might make all the difference. **The Horse Boy**, a new documentary from PBS, chronicles the story of Rowan Isaacson, an autistic boy who did not respond to modern medical treatment but started talking after befriending a neighbor's horse. This small success inspires his parents to bring him to Mongolia, the only place in the world where horses are an integral part of healing. [For a review of *The Horse Boy*, turn to page 68.]

Nationwide  
[www.horseboymovie.com/Film.php](http://www.horseboymovie.com/Film.php)

**11** Teens who begin drinking before the age of 15 are more likely to develop a dependence on alcohol later in life than those who start when they are older, according to a 2009 study by researchers at the Washington University School of Medicine in St. Louis. Understanding the neurological basis of alcoholism and other addictions is critical to treating these diseases. A public lecture series hosted by the **Duke Institute of Brain Research** focuses on how the brain is changed by addictive behaviors.

Durham, N.C.

[www.dibs.duke.edu/events/2010/05](http://www.dibs.duke.edu/events/2010/05)

## June

**6–9** The human brain can store many times the amount of information acquirable in a lifetime. [For more on our memory capacity, see Ask the Brains, on page 70.] Why did the brain evolve such complexity? The **18th Biennial Meeting of the International Society for Developmental Neuroscience** will highlight this mystery as neuroscientists from around the world gather to discuss their work on how the brain develops in the womb and throughout childhood. Attendees will also delve into the neural circuitry that underlies common diseases, including autism, Parkinson's disease and schizophrenia.

Lisbon, Portugal

[www.isdn-conference.elsevier.com](http://www.isdn-conference.elsevier.com)

## Ongoing

Chatting with a friend and listening to music may seem like mindless tasks, but the way the brain orchestrates these everyday activities is quite complex. The **Bloomfield Science Museum's** interactive exhibit *Journey through the Brain* illuminates the neural mechanisms underlying day-to-day cognition. In addition to the main exhibit, smaller ones investigate a variety of related topics. A display about illusions, for example, explores why the brain often makes sensory errors and how it responds to misperceptions. Another, called *Neuroscapes*, showcases images of neurons and neural networks.

Jerusalem, Israel

<http://brain.mada.org.il/museum-e.html>

## Knowledge Is Power

**Education efforts in May and June aim to bring attention to diseases that damage the brain and to gain support for the scientific work that could yield new treatments.**

### May 1–31

When a stroke occurs, blood supply to the brain is interrupted, and neurological damage follows rapidly. Some stroke victims may not be aware that they have had a stroke, wasting precious time. The more easily onlookers can spot warning signs, the better the victim's chances of quick medical treatment and recovery. During **National Stroke Awareness Month**, the National Stroke Association will teach people how to act "FAST," recognizing changes to the *face*, *arms* and *speech* during a stroke, to save *time* and even a life.

Nationwide

[www.stroke.org](http://www.stroke.org)

### May 1–31

Many people believe that multiple sclerosis, an autoimmune disease that damages the brain and spinal cord, is fatal. Canada's **Multiple Sclerosis Awareness Month** aims to clear up such misconceptions. MS is not a death sentence, but it can often be debilitating, causing loss of balance and slurred speech. In addition to publicizing the facts about MS, participants will raise money for research into the cause of the disease, which remains a mystery.

Canada

[www.mssociety.ca](http://www.mssociety.ca)

### June 4–11

In 2008 U.S. Senator Ted Kennedy (*right*) became one of the nearly 200,000 Americans each year who are diagnosed with a brain tumor. **Brain Tumor Action Week** helps to fund cutting-



edge research, such as the effort to target and eliminate tumor stem cells—seed cells that can regenerate a tumor again and again. [For more on this research, see "New Hope for Battling Brain Cancer," by Gregory Foltz; SCIENTIFIC AMERICAN MIND, March/April 2010.]

Nationwide

<http://btan.org>

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# The Truth about

The preference for playing hockey, or in the brain are small—unless grown-up

By Lise Eliot

Parents anticipate sex differences from the first prenatal ultrasound but then seem amazed when their son goes gaga over trucks or their daughter will wear nothing but pink. Boys and girls are obviously different, and in many cases the gaps between them seem stark. But stereotypes do not always hold up to scientific scrutiny. Are boys really more aggressive and girls really more empathetic—or do we just see what we expect in them? Where true sex differences exist, are those gaps inborn, as our current Mars-Venus obsession implies, or shaped by environment—that is, by us?

A natural place to look for answers is in the brain. If there is a neurological disparity between the genders, it could explain important behavioral differences. But surprisingly, researchers have found very few large-scale differences between boys and girls in brain structure or function. Yes, boys have larger brains (and heads) than girls—from birth through old age. And girls' brains finish growing earlier than boys'. But neither of these findings explains why boys are more active and girls more verbal or reveals a plausible basis for the consistent gaps in their reading, writing and science test scores that have parents and teachers up in arms.

Brain differences are indisputably biological, but they are not necessarily hardwired. The crucial, often overlooked fact is that experience itself changes brain structure and function. Neuroscientists call this shaping plasticity, and it is the basis of all learning and much of children's mental development. Even something as simple as the act of seeing depends on normal visual experience in early life, without which a baby's visual brain fails to wire up properly and his or her vision is permanently impaired.



JAMES BOULETTE / iStockphoto



# Boys and Girls

house, is far from fixed. Sex differences assumptions magnify them

Does growing up as a boy or as a girl also wire the brain in a particular way? Obviously, girls and boys are not identical at birth: genetic and hormonal differences must launch the male and female brain down somewhat different developmental pathways. But early experience, we now know, permanently alters the chemistry and function of the genes inside cells, leading to significant effects on behavior. Neuroscientist Michael J. Meaney and his colleagues at McGill University, among others, have found that the quality of maternal care is associated with a host of neural and psychological consequences—from the production of new brain cells to altered stress responses and memory function. The different ways parents raise boys and girls may similarly leave its stamp on their developing brains. [For more on how early care affects later behavior, see “The New Genetics of Mental Illness,” by Edmund S. Higgins; *SCIENTIFIC AMERICAN MIND*, June/July 2008.]

Most sex differences start out small—as mere biases in temperament and play style—but are amplified as children’s pink- or blue-tinted brains meet our gender-infused culture, including all the tea parties, wrestling matches, playground capers and cafeteria dramas that dominate boys’ or girls’ existence. Through better understanding of these environmental influences, we can break down some of the gaps between boys and girls—in school achievement, risk taking, competitiveness, empathy and conscientiousness.

JOAN VICENT AND CANTÓ ROIG iStockphoto



Boys tend to be more rambunctious than girls. Peer influences amplify innate triggers such as a relative abundance of testosterone in the womb.



### The Kickoff

Boys are more physically active than girls, in infancy and throughout childhood. They kick, swing their arms and race around the house noticeably

more than girls do, as many exhausted parents can testify. The difference may emerge before birth, although not every ultrasound study finds a sex difference in fetal movement. Nevertheless, the disparity is clear during the first year and expands through childhood, according to a 1986 analysis of more than 100 studies by psychologist Warren Eaton and his colleagues at the University of Manitoba in Canada, which reveals that the average boy is more active than about 69 percent of girls.

That gap is statistically moderate, larger than differences in verbal and math skills but small enough to permit many exceptions to the rule, notably the 31 percent of girls who are *more* active than the average boy. Sex hormones—in particular, a relative abundance of testosterone in the womb—appear to trigger boys' fidgetiness. And yet the sex difference in physical activity continues to widen during childhood, despite the fact that sex hormone levels do *not* differ between boys and girls from six months of age to puberty. Parenting is likely one factor amplifying the disparity. Mothers discourage physical risk taking more in daughters than in sons, suggest studies in the laboratory and on playgrounds. (Fathers encourage more risk taking in children than mothers do—see “Family Guy,” on page 46—but no one has studied whether dads pressure sons more than daughters in this respect.) Peers also push conformi-

#### FAST FACTS

#### Boy vs. Girl?

**1»** Boys and girls are different, but most psychological sex differences are not especially large. For example, gaps in intellectual performance, empathy and even most types of aggression are generally much narrower than the disparity in adult height, in which the average man is taller than 99 percent of women.

**2»** Researchers have found very few large-scale differences between boys and girls in brain structure or function. Boys have larger brains, and girls' brains finish growing earlier than boys' do. But neither of these findings explains why boys are more active and girls more verbal or reveals a plausible basis for any of the other emotional and cognitive differences between the sexes.

**3»** Experience itself changes brain structure and function. Most sex differences start out small—as mere biases in temperament and play style—but are amplified as children's pink- or blue-tinted brains meet our gender-infused culture.

DAVID C. ELLIS/Getty Images

## Even male and female monkeys prefer gender-stereotyped toys, telling us there is something about vehicles, balls and moving parts that resonates with boys' hormonal priming.

ty: in their preferred all-boy groups, energetic boys feed off one another, whereas energetic girls tend to settle down in clusters of more docile friends. In organized sports, girls start playing at a later age, quit earlier and join fewer teams overall than boys—differences that are influenced by parents and peers.

As many schools eliminate recess or cut back on physical education, both genders are paying the price with higher rates of obesity and attention-deficit hyperactivity diagnoses. Boys especially need more frequent physical breaks to satisfy their higher activity levels, and both sexes need the mental recharging that exercise confers during a long school day. Exercise is also important for maintaining a positive body image, which turns out to be the biggest risk factor for depression in adolescent girls.

### Boy Meet Barbie

Yes, boys like trucks and girls like dolls. Given a choice of Power Rangers, Tonka, Bratz and a Barbie beauty set, preschool-age boys and girls strongly prefer the gender-obvious picks. In fact, children's gendered toy choice is one of the largest sex differences in behavior, second only to sexual preference itself! But this preference is not nearly so clear in infancy, when boys, in many studies, have been found to like dolls as much as girls do. (All babies are strongly attracted to faces, for obvious survival reasons.) Rather, toy preference emerges toward the end of infancy, grows stronger through the preschool years and then declines somewhat because of a complex interaction of nature and nurture.

Toddlers' toy preference is shaped, in part, by prenatal testosterone: girls with a genetic disorder that exposes them to high levels of testosterone and other androgens before birth are much more interested in toy trucks and cars than typical girls are. Even male and female monkeys prefer gender-stereotyped toys, telling us there is something about vehicles, balls and moving parts that resonates with boys' hormonal priming, drawing them away from their initial face preference and toward toys they can interact with more physically.

Starting from this innate bias, children's toy preferences grow more extreme through social shaping. Parents reinforce play that is considered gender-appropriate, especially in boys, and beginning at age three, peers perpetuate gender norms

even more than adults do. In one example of peer influence, psychologists Karin Frey of the University of Washington and Diane Ruble of New York University reported in 1992 that elementary school-age boys and girls both opted for a less desirable toy (a kaleidoscope) over a slick Fisher-Price movie viewer after watching a commercial of a same-sex child choosing the kaleidoscope and an opposite-sex child choosing the movie viewer. And yet around age five, girls begin choosing "boy" toys and "girl" toys equally. Boys, however, rarely do this crossover—a divergence that reflects different societal



Boys' preference for trucks over dolls becomes stronger as parents and playmates push gender-appropriate toys. But encouraging boys to act as caretakers can improve their social skills.

### (The Author)

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## Competition can be highly motivating, especially for boys, and girls need to develop greater comfort with open competition, which remains an inescapable reality of our free-market culture.

norms. Girls today are allowed—and even encouraged—to play sports, wear pants and build with Legos much more than boys are pushed to don dresses and play house.

The different play preferences of boys and girls are important in shaping many mental circuits and later abilities [see “The Serious Need for Play,” by Melinda Wenner; *SCIENTIFIC AMERICAN MIND*, February/March 2009]. Sporting gear, vehicles and building toys tend to exercise physical and spatial skills, whereas dolls, coloring books and dress-up clothes tend to stimulate verbal, social and fine-motor circuits. Parents and preschool teachers can expand both sets of skills by encouraging girls to play with puzzles, building blocks, throwing games and even video games, while enticing boys to sew, paint, and play as caregivers using props for doctor, Daddy, zookeeper, EMT, and the like.

### Sticks and Stones

Boys are more physically aggressive than girls, according to many studies, including a 2004 analy-

sis by psychologist John Archer of the University of Central Lancashire in England. That difference is linked to prenatal testosterone but not, surprisingly, to the resurgence in boys’ testosterone level in adolescence, because boys do not suddenly become more aggressive when they go through puberty, as Archer’s work also indicates. Nor is this sex difference absolute. Two- and three-year-old girls, for instance, frequently kick, bite and hit other people—not quite as much as toddler boys but about three times more than either sex does later in childhood. In addition, girls fight with indirect, or relational, aggression. Through gossip, ostracism, whispers and, most recently, harassing text messages, girls leave more scars on competitors’ psyches than on their bodies. [For more on gender and aggression, see the Facts and Fictions in Mental Health column on page 64.]

Thus, both sexes compete and both sexes fight; what differs is the degree to which such behavior is overt or hidden. Because physical aggression is a much greater taboo for girls than boys, they learn,

Because physical aggression is a much greater taboo for girls than boys, girls learn to suppress overt belligerence. Instead they whisper and engage in best-friend wars that are much harder to police.



ALTRENDO IMAGES Getty Images

even early in elementary school, to keep it below the surface, in the eye rolling and best-friend wars that teachers rarely notice and are harder to police.

But by admitting that competitive feelings are natural for all children, we can find ways to channel them into healthier pursuits. In recent years educators have tended to take competition out of the classroom, reasoning that the opposite style of interaction—cooperation—is more important in a civil society. But competition can be highly motivating, especially for boys, and girls need to develop greater comfort with open competition, which remains an inescapable reality of our free-market culture. One solution is team competitions, where groups of students work together to try to beat others at solving math, vocabulary, history and science problems.

### I Know How You Feel

Aggression and empathy are inversely related. It is hard to attack someone if you are acutely aware of what he or she is feeling. So whereas men and boys score higher on measures of physical and verbal aggression, girls and women score higher on most measures of empathy, or the awareness and sharing of other people's emotions, conclude psychologist Nancy Eisenberg of Arizona State University and her colleagues in studies dating back to the 1980s.

And yet the sex difference in empathy is smaller than most people realize and also strongly dependent on how it is measured. When men and women are asked to self-report their empathetic tendencies, women are much likelier than men to endorse statements such as "I am good at knowing how others will feel" or "I enjoy caring for other people." When tested using more objective measures, however, such as recognizing the emotions in a series of photographed faces, the difference between men and women is much smaller, about four tenths of a standard deviation, meaning the average woman is more accurate than just 66 percent of men.

In children, the difference is tinier still, less than half that found in adults, reported psychologist Erin McClure of Emory University in 2000 after analyzing more than 100 studies of sex differences in facial emotion processing in infants, children and adolescents. So although girls do start out a bit more sensitive to other people's faces and emotions, their advantage grows larger with age, no doubt because of their stronger communication skills, more practice at role playing with dolls and more intimate friendships as compared with boys.

Little is known about the neural basis for the sex difference in empathy, although a grape-size region on each side of the brain called the amygdala is like-



Girls score higher than boys on most measures of empathy. But grown-ups can nurture and encourage boys' natural sensitivity.

ly to be involved. The amygdala is highly activated by faces. According to a 2002 analysis of several studies, the amygdala is larger in men than in women, a fact that seemingly belies men's lesser ability to recognize facial emotions. Other studies reveal an imbalance in the activation of the right and left amygdala in men and women, however. When they are recalling highly charged emotional scenes—the kind that trigger empathetic responses—women's left amygdala is more strongly activated than their right amygdala, whereas the right amygdala is more strongly activated than the left in men, as indicated by both a study in 2004 led by neurobiologist Larry Cahill of the University of California, Irvine, and a report in 2002 by psychologist Turhan Canli, then at Stanford University, and his colleagues.

It is not yet known if this left-right difference in amygdala activation is related to empathy per se or if the same neural sex difference is present in children. Indeed, when it comes to emotionality, boys and girls differ much less in early life; if anything, baby boys are known to cry and fuss *more* than baby girls. As boys grow, they—much more than girls—are taught to hide their expressions of fear, sadness and tenderness. Scientists agree that social learning largely shapes the male-female gap in emotional responding. Boys are toughened up in a way girls rarely are, making them less expressive but also less attuned to others' feelings. This training almost certainly leaves its imprint on the amygdala, one of the

more plastic structures in the brain. Teaching girls to be more resilient and boys to be more sensitive is possible and beneficial for both genders.

### Girl Talk

Let us dispense with the urban legend that “women speak three times more words every day than men.” The real numbers: 16,215 for women and 15,669 for men, according to a 2007 study of nearly 400 college students fitted with digital recorders, led by psychologist Matthias Mehl of the University of Arizona. Females do outscore males on most measures of speaking, reading, writing and spelling from early childhood and throughout life, but the gaps are generally small and change with age.

Girls read more than boys, and the extra practice results in better scores on language proficiency tests. But schools with strong reading programs show that boys who read a lot are as verbally adept as their female classmates.



literacy differences have yet to be uncovered. In 2008 neuroscientist Iris Sommer and her colleagues at University Medical Center Utrecht in the Netherlands dispelled one popular theory—that women use both sides of the brain to process language, whereas men use mainly the left. In their analysis of 20 functional MRI studies, the researchers detected no difference in the degree of language lateralization between men and women.

Similarly, there is scant proof that girls and women are better neurologically wired for reading. If anything correlates with reading skill, it is quite simply the amount of reading children do for pleasure outside school. Girls read more than boys, and this additional exposure makes a difference in their academic performance.

Beginning at birth, a child’s language exposure is the single most important determinant of his or her later verbal abilities. Large studies in several different countries demonstrate that gender accounts for at most 3 percent of the variance in toddlers’ verbal ability, compared with at least 50 percent determined by a child’s environment and language exposure. Thus, the more parents can immerse their sons in conversation, books, songs and stories, the better are boys’ chances of getting off to the right start in language and literacy skills.

**Gender counts for at most 3 percent of the variance in toddlers’ verbal ability. By comparison, about 50 percent is determined by a child’s environment and language exposure.**

Language differences emerge early in development. As infants, girls begin talking about one month earlier than boys and are some 12 percent ahead of boys in reading skills when kindergarten begins. Girls’ advantage in reading and writing continues to grow through school, until by 12th grade, an alarming 47 percent more girls than boys graduate as proficient readers, with an even larger gap for writing, a conclusion drawn from several decades of data collected by the U.S. Department of Education.

These gaps appear to shrink in adulthood, however. The average woman scores higher than just 54 percent of men on a combined measure of all verbal skills, indicates a 1988 analysis by psychologist Janet Hyde and her colleagues at the University of Wisconsin–Madison. That the difference is so tiny may explain why the neural bases for language or

ABC and rhyming books are great for teaching phonemic awareness—the link between sounds and letters that is the first hurdle in learning to read. As compared with girls, boys often select different genres—especially nonfiction, comedy and action stories—so getting boys to read may be largely a matter of finding books and magazines that appeal to them. Schools with strong reading programs have managed to eliminate the difference between boys’ and girls’ scores, proving that this worrisome gap is more a matter of education and practice than inborn literacy potential.

### Thinking in 3-D

If girls have the advantage in verbal skills, boys have it in the spatial domain—the ability to visualize and manipulate objects and trajectories in time

AGE FOTOSTOCK

and three-dimensional space. Sex differences in spatial skills are among the largest of the cognitive gaps. The average man can perform mental rotation—that is, he can imagine how a complex object would look when turned around—better than up to 80 percent of women.

In 2008 two research groups reported a sex difference in mental rotation in babies as young as three months of age, and other evidence suggests that this skill is influenced by prenatal testosterone. Yet the actual size of the skill gap is much smaller in children than in adults: among four-year-olds, the average boy outperforms just 60 percent of girls. So it seems likely that the skill improves in boys thanks to the wide range of visuospatial interests—targeting, building, throwing and navigating through innumerable driving and shooting games—that they pursue far more than girls. In support of this idea, neurobiologist Karin Kucian and her colleagues at University Children’s Hospital in Zurich reported in a 2007 study that boys’ and girls’ brains display similar MRI patterns of neural activity while performing a mental rotation task that, as a 2005 study by the same researchers revealed, evokes different responses in the brains of adult men and women. So it appears that boys’ and girls’ brains diverge in spatial processing as they grow and practice different skills.

Spatial skills are important for success in several areas of science and higher math, including calculus, trigonometry, physics and engineering. Research by educational psychologist Beth Casey of Boston College shows that the spatial skill gap between boys and girls largely accounts for the consistent male advantage on the math SAT exam, an obvious hurdle for admission to engineering and other technical degree programs.

As important as they are, spatial skills are not something we deliberately teach in school. But many studies have shown they can improve with training, including playing video games! If boys naturally get more such practice in their extracurricular pursuits, girls may benefit from greater exposure to three-dimensional puzzles, fast-paced driving and targeting games, and sports such as baseball, softball and tennis.

### Gender, Culture and the Brain

Boys and girls are different, but most psychological sex differences are not especially large. For example, gaps in verbal skills, math performance, empathy and even most types of aggression are generally much smaller than the disparity in adult height, in which the average five-foot, 10-inch man



is taller than 99 percent of women. When it comes to mental abilities, males and females overlap much more than they stand apart.

Furthermore, few of these sex differences are as fixed, or hardwired, as popular accounts have lately portrayed. Genes and hormones light the spark for most boy-girl differences, but the flame is strongly fanned by the essentially separate cultures in which boys and girls grow up. Appreciating *how* sex differences emerge can reduce dangerous stereotyping and give parents and teachers ideas for cross-training boys’ and girls’ minds, to minimize their more troubling discrepancies and enable all children to more fully develop their diverse talents. **M**

To narrow the gender gap in spatial skills, girls can practice visualizing and moving objects through space by playing targeting games and sports such as archery, baseball and tennis.

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# Different Shades of Blue

Women get sad. Men get mad.  
Depression comes in many hues

By Erica Westly

To Emily Dickinson, it was “fixed melancholy.” To essayist George Santayana, it was “rage spread thin.” The turns of phrase conjure different emotions, but these two writers were describing the same disorder: depression. The variance is more than a matter of literary or philosophical differences; it also reflects the fact that one was a woman, the other a man.

Therapists have long known that men and women experience mental illness differently. Yet when clinicians designed the *Diagnostic and Statistical Manual of Mental Disorders*, the guidebook they use to diagnose psychiatric maladies, they purposely made the disease descriptions gender-neutral. Today evidence is mounting that in turning a blind eye to gender, clinicians are doing their patients a disservice. In fact, as more researchers investigate sex differences in depression and other mental illnesses, the inescapable conclusion is that gender influences every aspect of these disorders—from the symptoms patients experience to their re-

TARA MOORE/Getty Images (left); GETTY IMAGES (right)





sponse to medication to the course of a disorder throughout a person's life.

Depression is the most common psychiatric disorder in the world, affecting more than 150 million people, according to the World Health Organization, or roughly 4 percent of the global adult population. In the U.S., the incidence is higher—48 million people, or 19 percent of the adult population, as reported in a recent survey conducted by the Centers for Disease Control and Prevention. (The higher U.S. figure may be linked in part to greater awareness of the disorder.)

The most obvious difference between male and female depression is prevalence. Population studies indicate that women are about twice as likely to be afflicted as men. As a result, research on depression and gender has historically focused on why women are more vulnerable to the ailment—even though, for reasons mainly to do with convenience, most studies of antidepressant drugs have recruited only male subjects.

More recently, however, researchers have started to study the deeper dissimilarities. Perhaps the most important of these, and the one most frequently misunderstood by people of both genders, is the difference in symptoms expressed by women and men. For women, the primary emotion of depres-

sion is usually sadness. For men, it is more typically anger or irritability, often coupled with recklessness. As a result, many women and men, including depressed men, mistake male depression for general frustration and restlessness rather than a serious disorder in need of intervention. Depressed men are also much less likely to seek help than depressed women, and they are much more likely to kill themselves. According to the CDC, the male-to-female suicide ratio is four to one.

The big question is whether the variations are a matter of biology or culture. Some researchers believe the brain chemistry of depression is the same in men and women but that social norms do not let men express sadness, so they often have difficulty articulating their symptoms. “They’ll say, ‘I’m not getting as much done,’ or ‘I keep getting into fights with my girlfriend,’ rather than ‘I’m sad,’” says Sam Cochran, director of counseling at the University of Iowa and author of books on male psychology. “But once we get past that, the symptoms are pretty much the same as for the female patients.”

Cochran and others who emphasize the importance of cultural influences are increasingly in the minority. An ever growing body of evidence suggests that biology sets men and women apart in ways that have real consequences for mood and behav-

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estrogen, play a leading role in brain development and, later on, in mood—and not simply in setting the stage for life’s prime directive: reproduction.

Men and women make each hormone in varying amounts. Testosterone, produced in the testes, and estrogen, manufactured in the ovaries, are the most active sex hormones in men and women, respectively, but men make some estrogen and women some testosterone in their sex organs and adrenal glands. The other gender’s hormone plays a vital role in men and women alike. Testosterone helps women regulate menstruation and maintain bone density, muscle mass and libido; estrogen helps men regulate fluids in their reproductive tract.

The production of sex hormones varies over a life span. Hormone levels can fluctuate from day to day and even from hour to hour. But in broad terms, output spikes first in infancy and early childhood and again in the preteen years, triggered by the hypothalamus and pituitary gland and heralding the onset of puberty. Levels of the sex hormones decline

## Starting in the womb play a leading role in

gradually from the late teens to the early or mid-50s, when women enter menopause, after which estrogen production drops sharply, and men enter a state many doctors are calling andropause, marked by a not quite so steep falloff in testosterone production. In men and women alike, researchers have linked the depleted hormone levels of old age to cognitive decline and memory loss.

The biochemistry of sex hormones in the brain is difficult to study because the hormones themselves are hard to measure and their effects are so widespread. But the evidence is strong for a primary role in gross brain physiology. The male brain tends to be larger than the female brain and matures more slowly. Although scientists have not yet pinpointed the mechanism behind the delay, animal research has shown that testosterone can increase brain size by stimulating the production of brain-derived neurotrophic factor (BDNF), a protein that contributes to neuron development. The additional growth may mean that the male brain needs more time to reach full maturity.

Much evidence also points to a relation between sex hormones and mood disorders over the course of a lifetime. Testosterone and estrogen have different effects on the brain’s neurotransmitters, particularly in the hypothalamus and amygdala, both of

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Many men do not express sadness when depressed, veering instead to irritability. Couple their less recognizable symptoms with a reluctance to admit weakness, and men often go undiagnosed.

ior—including their susceptibility to depression and other psychiatric disorders. Perhaps not surprisingly, these differences emerge from the very substances that define gender in the first place: sex hormones. Understanding the effects of these hormones on the brain may be the only way to make sure that every depressed patient gets the right treatment.

### Engines of Mood

Starting in the womb and continuing through adolescence, the sex hormones, mainly testosterone and

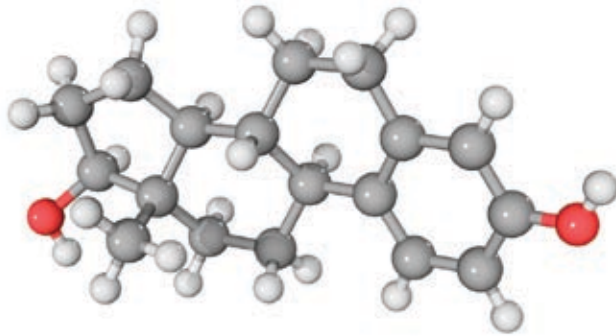
#### FAST FACTS

### The Biochemical Blahs

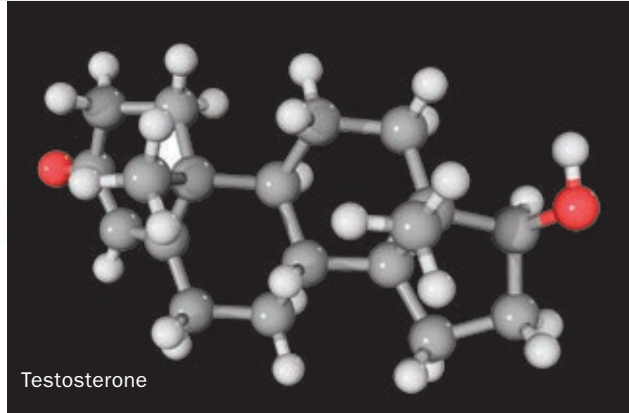
- 1>> The sex hormones estrogen and testosterone interact differently with the neurotransmitters responsible for feelings of stress and well-being. As a result, men and women vary in their experience of depression and their response to antidepressants.
- 2>> Men tend to exhibit less recognizable symptoms of depression, such as anger and restlessness.
- 3>> Hormones surge and shift over a life span, making men and women susceptible to depression at different times.

## Hormones: His and Hers

As molecules go, estrogen and testosterone are similar (in the models below, the dark gray atoms are carbon; the light gray ones, hydrogen; and the red ones, oxygen). But small structural differences can have a big impact. There are separate receptors for estrogen and testosterone in several brain regions, including the hypothalamus and amygdala—areas that regulate memory, emotion, sleeping and appetite. And the two sex hormones react differently with other molecules. Estrogen, for example, can raise levels of the stress hormone cortisol, which may help explain the higher rates of depression among women.



Estrogen



Testosterone

and continuing through adolescence, the sex hormones brain development and in mood.

which are involved in emotional processing. For example, studies conducted at the Albert Einstein College of Medicine in 2001 showed that during early development, testosterone and estrogen have the opposite effect on the neurotransmitter gamma-aminobutyric acid (GABA): testosterone stimulates GABA transmission; estrogen inhibits it.

These polarizing effects favor first one gender and then the other. In childhood, the differences are toughest on boys. Because excess GABA is associated with seizures in infants and toddlers, estrogen's dampening effect on GABA is likely to be protective, and boys are almost twice as likely as girls to have febrile seizures. Boys also have a greater chance of developing depression during early childhood. Simon Baron-Cohen, a psychologist and director of the Autism Research Center at the University of Cambridge, argues that excesses in testosterone during the first months of brain development may make boys vulnerable to autism and other neuropsychiatric disorders. GABA, BDNF and other chemical factors that are also spurred by testosterone seem, for reasons still unknown, to be linked to these disorders. Other researchers believe that testosterone's role is indirect, making boys more sensitive to environmental stresses such as low prenatal oxygen, which in turn may produce psychiatric symptoms.

During puberty, the gender balance shifts, with girls becoming two to three times more prone to depression than boys. Researchers say surges in estrogen levels may make girls susceptible by boosting levels of cortisol, the stress hormone, and by interfering with supplies of serotonin; shortages of serotonin at that stage in life can lead to fatigue, anxiety and other symptoms of depression. For boys, testosterone may now play a protective role. In a study published in 2008 by Tracy Bale and her colleagues at the University of Pennsylvania, testosterone administered to female mice appeared to shield them from depressionlike symptoms, but only when given during adolescence, implying that what matters is not only which hormones the body expresses but when.

### Unmasking the Symptoms

The strands of the nature-versus-nurture debate are even harder to unravel as patients enter adulthood, when symptoms of depression begin to diverge more clearly by gender. Because women are

### (The Author)

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Boys have a greater chance of developing depression during early childhood. Girls, in contrast, are two to three times more prone to the disorder during puberty.



## One of the organization's top support groups discussing how best to convince their husbands

so much more likely to have the disorder and to present themselves for treatment, the diagnostic criteria for depression skew heavily toward female symptoms. The anger and restlessness typical of male depression simply do not fit the traditional definitions of the disorder, so the tests can miss men. Nor does depression fit the traditional notions of the kind of malady a man would have; for that reason, an awareness-raising campaign in 2003 sponsored by the National Institute of Mental Health (NIMH) was called "Real Men, Real Depression."

Julie Totten of Waltham, Mass., vividly remembers the day she realized that her 54-year-old father's irritability and anger might be symptoms of depression. It was in 1990, shortly after her brother had killed himself. She had gone to the library to research possible causes of suicide and came across an article on depression in men. "When my father was

well, he was social and outgoing, but he could also be very irritable and gloomy about everything," she says. "When he was like that, you learned to tread lightly." Her father, it seemed, was experiencing Santayana's rage spread thin.

Totten knew she would have a hard time persuading her father to see a doctor. Her brother had sought help from his family physician shortly before he died, but he complained only of external problems, such as stomachaches and weight loss. The doctor told him to eat more. Totten got her father proper care through subterfuge. She took him to his doctor when he thought he had the flu and arranged for a psychiatrist to come by during the visit. He was diagnosed with depression and put on a selective serotonin reuptake inhibitor, or SSRI, which he continues to take. Now Totten runs an organization called Families for Depression Awareness to help

WIN-INITIATIVE/GETTY IMAGES

people recognize signs of the disorder in their loved ones and get them into treatment. She says one of the biggest support groups within the organization consists of women discussing how best to convince their husbands to seek help.

Indeed, for depressed men, seeing a doctor sooner rather than later could mean the difference between life and death. As the title of a recent journal article touching on the high male suicide rate put it, “Women seek help, men die.” Some researchers now advocate using rating systems designed for men, such as the Gotland Male Depression Scale, a questionnaire developed in 1999 that focuses on men’s symptoms. Respondents are asked to specify, for example, the degree to which they feel irritable, restless, frustrated or aggressive.

### The Medication Gap

Just as important as getting the diagnosis right is making sure men and women get treatment that fits their gender. For a long time, clinicians assumed psychiatric medications had the same effects on both sexes. But 10 years ago Susan Kornstein, a psychiatrist at Virginia Commonwealth University, published a study showing that men did not respond as well as women did to SSRIs, the class of antidepressant that includes Prozac, Zoloft and Lexapro. “It caused quite a stir,” recalls Kornstein, not to mention some red-faced defensiveness, because the clinical trials that had led to FDA approval for SSRIs had

found that female patients were also more likely than male patients to experience remission after SSRI treatment, even though the depression of the female patients was on average more severe.

In contrast, Kornstein’s earlier study found that men respond better to antidepressants such as imipramine (Tofranil) and bupropion (Wellbutrin) that target the neurotransmitters dopamine and norepinephrine instead of serotonin. A few years ago researchers at the NIMH and Yale University published a study that could explain why. They used PET scans to measure levels of the serotonin

## Separate Couches

Some researchers argue that many, if not all, mental illnesses affect men and women differently. [To learn how gender affects addiction, see “She’s Hooked,” on page 14.]

### Schizophrenia

This disorder afflicts men and women in equal numbers but in different ways. Female patients are more likely to experience anxiety and depression; male patients more commonly exhibit apathy and poor social functioning. Studies show that men with schizophrenia are more likely to have cognitive deficits, such as language difficulties.

Physical differences appear to be common as well. A recent study by Harvard University psychologist Jill Goldstein found that the hypothalamus, a brain region involved in emotional processing, was enlarged in female but not male schizophrenics.

### Post-traumatic Stress Disorder

Women seem more susceptible to this illness: they are about twice as likely to develop PTSD as men, even though men are about four times more likely to experience traumatic events, according to a 2008 study published in the *Annals of General Psychiatry*.

Women with PTSD are more likely than men to be detached and withdrawn, as reported recently in the *British Journal of Psychiatry*, but male PTSD is usually characterized by irritability and impulsive behavior. PTSD is more likely to be associated with depression in women and anxiety in men.

### Bipolar Disorder

Men and women have an equal likelihood of developing bipolar disorder, but men tend to show signs earlier, with onset at an average age of 22 in men and 26 in women. Women, though, tend to sink to lower lows than men and to cycle between depression and mania more frequently.

Researchers believe antidepressants may exacerbate this so-called rapid cycling effect, which may explain why it occurs more in women: their depression is more likely to be severe, so they are more likely to take medication for it.

Cognitive side effects of the disorder also vary with gender. A 2009 study in *Psychological Medicine* found that bipolar disorder was associated with short-term memory deficits in men but not in women.

consists of women  
to seek help.

involved men only. “Researchers didn’t want to deal with the difficulties of controlling for menstrual cycles,” says Kornstein, now director of the university’s Institute for Women’s Mental Health, so they excluded women from the trial and did not consider that the female response to the drug might be different.

But the work by Kornstein and others reveals a real gender gap for SSRI efficacy. Several recent studies suggest that these heavily prescribed medications—17 million people reported taking them between 2003 and 2006, according to the CDC—work best in the presence of estrogen. A 2008 study published in the journal *Psychoneuroendocrinology* found that the SSRI sertraline (Zoloft) had no effect on female rats that did not produce estrogen. The drug improved their depressionlike symptoms, however, if accompanied by estrogen treatment. When Kornstein conducted a follow-up study last year, she

# Antidepressants like Prozac and Zoloft work better like estrogen. In other words, they work better

transporter protein—the target of SSRIs—in male and female patients who had taken antidepressants in the past but were not currently on them. Although young women showed a 22 percent reduction in the serotonin transporter in key brain regions, male patients showed no difference from healthy controls, implying that for men, depression may have less to do with serotonin deficits.

Reinforcing these results is the finding that women respond differently to antidepressants at different times of life—which may, in turn, point to why women are more likely to have depression in the first place. Kornstein found that, as with male patients, postmenopausal women did not respond as well to SSRIs as younger women did and had better results with antidepressants targeting norepinephrine and dopamine. Additionally, the Yale re-

searchers discovered that unlike younger women (and like men), depressed postmenopausal women showed no reduction in serotonin transporter levels. These findings dovetail with the evidence in animals that SSRIs perform best in the presence of estrogen and reveal the influence of estrogen on mental health over the course of a lifetime—from the adolescent spike that permanently alters the brain's stress pathways to the loss of estrogen in menopause that has profound effects on the brain's circuitry and on women's response to medication.

## The Importance of Timing

Like many women with depression, Deb Damone, 56, of Hauppague, N.Y., first experienced what she calls “a foreboding sadness” when she hit puberty. By 17 she had been diagnosed and began

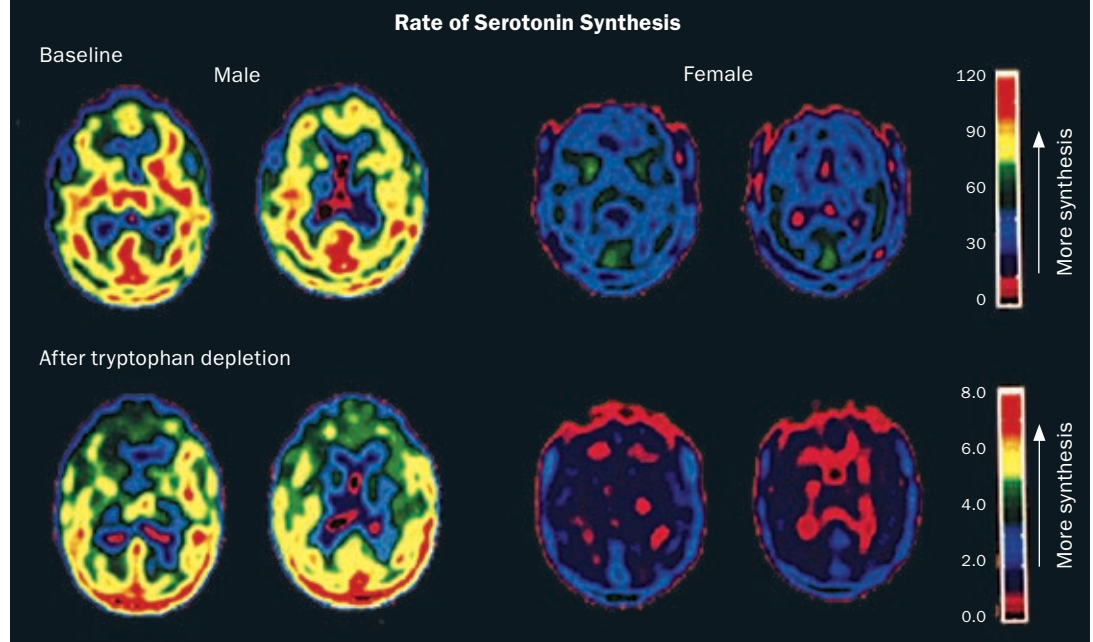
## Different Set Points

Human brains run on the same chemicals, but men and women may produce them in varying amounts—a gap that can put one gender at a disadvantage. Below are brain images made by Canadian investigators who used positron-emission tomography to track the production of serotonin, a mood-boosting neurotransmitter, in 15 men and women.

The top row shows pairs of brain “slices” taken from two study subjects—one man and one woman, both of whom were healthy and not depressed. The man's brain made serotonin faster. The bottom row

shows serotonin production in the same two people after they were put on a low-protein diet lacking the amino acid tryptophan. (Found in turkey, dairy products and some fish, tryptophan is a critical building block of serotonin.) Under these challenging conditions, both people slowed their serotonin production, but the man still made it faster.

This apparent gender variation in the amount of circulating serotonin may help explain why antidepressants such as Prozac that elevate serotonin levels may be more effective in women.



SOURCE: FROM “DIFFERENCES BETWEEN MALES AND FEMALES IN RATES OF SEROTONIN SYNTHESIS IN HUMAN BRAIN,” BY S. NISHIZAWA ET AL., IN PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES USA, VOL. 94, NO. 10, MAY 13, 1997

## best in the presence of for women.

taking a tricyclic antidepressant (SSRIs did not yet exist). The drug was ineffective. She avoided antidepressants until her late 30s, when a doctor put her on Prozac, which worked better. In her early 50s, though, she entered menopause, and her symptoms worsened. She was prone to mood swings and extreme sadness—Emily Dickinson’s fixed melancholy—and had trouble getting out of bed. “My behavior hadn’t been that erratic since I was a teenager,” she says. “I assumed I would have been in even worse shape had I not been taking Prozac.” In fact, Damone might have had better results if she had been able to take Prozac as a young adult and then switched after menopause to a drug that targeted norepinephrine, such as venlafaxine (Effexor). Clinical psychologist Jill Goldstein, who studies sex differences in schizophrenia and depression at Harvard University’s Brigham and Women’s Hospital, says: “We need to put into place the notion that it takes a life-span perspective to understand these disorders.”

Goldstein has been putting her theory into practice using data from the New England Family Study, which kept medical records on thousands of children born in the region during the 1960s. The study grew out of the National Collaborative Perinatal Project, a National Institutes of Health project that followed 66,000 pregnancies in 12 cities across the U.S., starting in 1959. The researchers accumulated a trove of material, including maternal and umbilical cord blood samples and detailed medical histories of the children—all the data they might need to conduct retrospective studies on any number of conditions over the lives of the participants.

Funding for the project ran out in 1967, but the study materials are now available to researchers; it is one of the largest collections of prenatal and postnatal samples in the world. Researchers at the University of Minnesota recently used the materials to study links between childhood birthmarks and skin cancer in adults (they found a positive association). Others have drawn on the samples to investigate connections between childhood obesity and heart disease, maternal smoking and child nutrition, and lead exposure and schizophrenia.

A few years ago Goldstein, along with colleagues at Harvard and at Brown University, recruited about 1,000 of the original participants, now mostly in their 40s, for a follow-up study on depression. The researchers are looking for developmental factors linked to the disorder, many involving sex differenc-

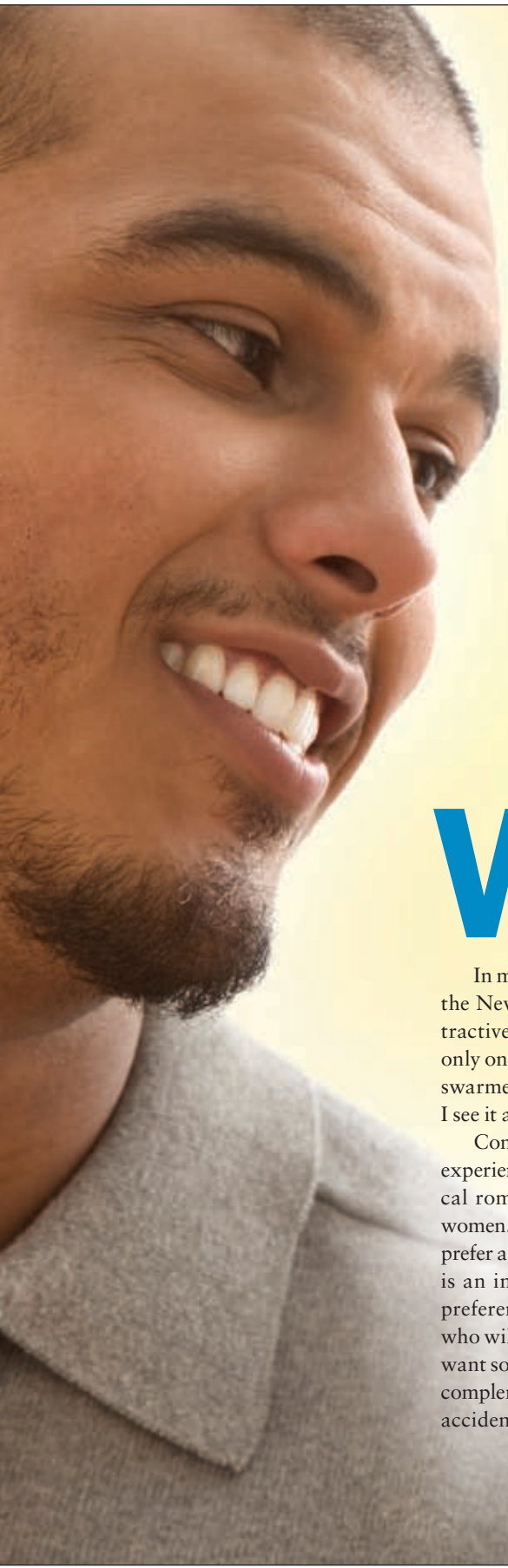
es, with the hope of revealing hormone-driven neurochemical pathways. They are also conducting functional MRI scans to evaluate gender differences in key areas of the brain that are involved in mood, such as the hypothalamus and the amygdala. Goldstein suspects the fMRI scans of depressed women will show decreased activity in the regions of the cortex that regulate the brain’s stress response.

Medicine, particularly psychiatry, has often struggled with sex stereotyping. Throughout the Victorian era and into the early 1900s, women displaying psychiatric symptoms were frequently diagnosed with hysteria, a “female” disorder no longer recognized by the medical community. As the profession shed such misogynistic views, it veered in the other direction, essentially stripping gender from diagnosis and treatment. As recently as January, in a widely publicized analysis claiming that patients with mild depression do not benefit much from antidepressants, the authors could not, when asked, break out the results by gender; they did not have the data that would have allowed them to do so.

Such oversights would disappear if scientists could marshal all they are learning about the biology of depression in men and women. This knowledge could help patients find treatments more finely attuned to their body chemistry. And beyond purely medical considerations, a more sophisticated understanding of the nuances of human emotion—that depression is melancholy to some, rage to others—would deepen our knowledge of one another and of ourselves. **M**

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# The Humor Gap

**W**hen comedian Susan Prekel takes to the stage and spots an attractive man in the audience, her heart sinks. “By the end of my gig he’s going to find me repulsive, at least as a sexual being,” she says.

In more than a decade of performing on the New York City comedy circuit the attractive, tall brunette has been asked out only once after a show. But male comics get swarmed. “They do very well with women. I see it all the time,” Prekel says.

Comedians, it turns out, may simply be experiencing an extreme version of the typical romantic interplay between men and women. Although both genders consistently prefer a partner with a sense of humor, there is an intriguing discrepancy in how that preference plays out. Men want someone who will appreciate their jokes, and women want someone who makes them laugh. The complementary nature of these desires is no accident. Researchers suspect humor has

deep evolutionary roots—in 1872 Charles Darwin noticed chimps giggling as they played—and many argue that the laws of natural selection can help explain the complex senses of humor we have today.

Men and women use humor and laughter to attract one another and to signal romantic interest—but each gender accomplishes this in a different way. And as a relationship progresses, the way men and women use humor changes; it becomes a means of soothing one another and smoothing over rough patches. In fact, humor is rarely about anything funny at all; rather sharing a laugh can bring people closer together and even predict compatibility over the long haul.



## Men and women may have different roles when it comes to comedy, but laughter is crucial from flirtation through long-term commitment

By Christie Nicholson

Humor in all its forms—sarcastic, witty, anecdotal, ironic, satirical—is as complicated and evolved as language. It can be a weapon used to alienate and a means to communicate interest and intelligence. So at the risk of unweaving a rainbow, it's time to take a serious look at humor.

### Make Me Laugh

It was when scientists started watching men and women *be* funny, in addition to studying what people *found* funny, that interesting patterns emerged. “The literature prior to the 1990s focused on joke appreciation,” says Martin Lampert, humor expert and chair of social sciences at Holy Names University in Oakland, Calif. “This was a contrived situation where subjects were presented with jokes and we documented their reaction.” Experiments then started to look at humor production, asking subjects to come up with jokes or studying how people amuse one another in the real world. “This

gave us a much more accurate picture of what was happening,” Lampert says.

In 1996 Robert R. Provine, professor of psychology at the University of Maryland, analyzed 3,745 personal ads and found that women sought a mate who could make them laugh twice as often as they offered to return the favor. Men, on the other hand, *offered* humor about a third more than they requested it. These findings were the first big clue that the sexes were approaching humor from different angles.

Ten years later Eric R. Bressler of Westfield State College and Sigal Balshine of McMaster University revealed another intriguing gender difference. The psychologists showed 200 people photographs of men and women, each paired with either a funny or a fairly straight autobiographical statement. Women chose the funnier men as potential dates, but men showed no preference for the funny women (as Prekel, the comedian, has been witnessing in the real world). And yet





Are funny women sexy? Maybe not: men prefer women who laugh at their jokes over women who make them laugh.

all over the world, both sexes consistently rank a sense of humor as one of the most important traits in a mate—so why the disparity?

“Although both sexes *say* they want a sense of humor, in our research women interpreted this as ‘someone who makes me laugh,’ and men wanted ‘someone who laughs at my jokes,’” says Rod A. Martin of the University of Western Ontario. In 2006 Martin, along with Bressler and Balshine, asked 127 subjects to choose between pairs of po-

tential partners for either a one-night stand, a date, a short-term relationship, a long-term relationship or friendship. In each pair one partner was described as receptive to the participant’s humor but not very funny themselves, and the other partner was described as hilarious but not all that interested in the participant’s own witty remarks.

In every context other than friendship, men preferred women who would laugh at their jokes to those who made jokes. Women, however, preferred partners who were funny.

The fact that a man and a woman complement each other when they offer and request humor is striking because laughter is not under our conscious control, Provine points out. And as with many behaviors that occur outside of our awareness, researchers suspect these opposing desires may have arisen because they serve a reproductive purpose.

### Why Funny Men Are So Attractive

From an evolutionary perspective, the sex that contributes more resources to the development of offspring will likely be the choosier of the two. In all mammals, that choosier sex is the female, because of the burden of pregnancy. So the male must compete for female attention—think of the courtship displays of bucks with their grand antlers. When a female is drawn to an impressive performer, she is unknowingly responding to his genetic health—thereby increasing the likelihood that her offspring will survive.

This evolutionary force is referred to as sexual selection, and psychologist Scott Barry Kaufman of New York University thinks it may explain why humor is so important in early courtship and why men produce the jokes while women appreciate them. “Humor is pretty sexy at first meeting. When you have little else to go on, a witty person who uses humor in a clever, original way is signaling quite a lot of information, including intelligence, creativity, and even aspects of their personality such as playfulness and openness to experience,” says Kaufman, who has done studies on the role of creativity in humor.

Supporting this idea are studies that show that humor is a good indicator of intelligence—a highly prized, heritable trait. For instance, in 2008 Daniel Howrigan of the University of Colorado at Boulder asked nearly 200 people to create humorous statements and draw funny images. Those who scored higher on a test of general intelligence were also rated by observers as being significantly funnier.

A more subtle test of the sexual selection hypothesis for humor depends on what women want

J. EMILIO FLORES New York Times/Redux Pictures (Kathy Griffin, this page); GETTY IMAGES (preceding pages)

#### FAST FACTS

#### Laughter and Love

- 1>> When seeking a mate, men desire women who laugh at their jokes, whereas women prefer men who can make them laugh.
- 2>> These complementary desires may be rooted in the evolutionary force of sexual selection, whereby one sex performs or competes for the other, choosier sex’s attention.
- 3>> Once a man and woman are in a relationship, humor roles change—it becomes important for women to use humor to relieve tense discussions.



When a man and woman are talking, the amount of female laughter is a good indication not only of the woman's interest but also of the man's level of attraction to her.



When women are ovulating, they choose funny men such as David Letterman over wealthy businessmen such as Donald Trump. During the rest of their cycle, they show no preference.

when they are at their most fertile—during ovulation. A large body of research has shown that when considering short-term partners, ovulating women tend to prefer men who have signs of good genes, such as body symmetry, masculine facial features and behavioral dominance. In contrast, when considering long-term partners at any point in their cycle, women show no preference, often choosing men with resources (in this day and age, that means money) and nurturing characteristics—in other words, good dads.

If humor is a sign of creativity and intelligence and hence an indicator of high-quality genes, funny guys should be highly desirable to women when they are ovulating. Indeed, a 2006 study by Geoffrey Miller of the University of New Mexico and Martie Haselton of the University of California, Los Angeles, showed exactly that. Forty-one women read descriptions of creative but poor men and uncreative but wealthy men and rated each man's

desirability as a short-term mate. During high fertility, women chose creative men about twice as often as wealthy men for short-term pairing, but no preference emerged for long-term partners—exactly the pattern one would expect.

So if being funny is what it takes to get the girls, then making others guffaw should be a priority for guys. Think back on the class clowns you've known. Were they boys?

And while the boys were clowning, chances are the girls were giggling. Studies of laughter also reveal clues about humor's important, evolved role in courtship, as Provine discovered when he started studying spontaneous conversation in 1993. He had tried studying laughter in the laboratory, but plop-

### (The Author)

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COMMERCIAL EYE/GETTY IMAGES (bar scene); GETTY IMAGES (Letterman); SARA DE BOER Retna Ltd./Corbis (Trump)

Women and men are funny in different ways. Female comedians such as Tina Fey may lean more toward storytelling and humorous narrative. Men often offer one-liners and slapstick, exemplified by Michael Richards as the character Kramer of *Seinfeld* fame.



ping a person in front of a TV with a couple of *Saturday Night Live* episodes did not incite much hilarity. Provine came to the stark realization: laughter is inherently social. So he set out, like a field primatologist, to observe human interaction in urban spaces: malls, sidewalks, cafes. He made note of about 1,200 laugh episodes—comments that elicited a laugh from either the speaker or the listener—and figured out which gender laughs when.

The results may not come as a surprise. Women, in general, laugh a lot more than men, according to Provine's data—especially in mixed-sex groups. “Both men and women laugh more at men than at

Reiss of Stanford University showed men and women 30 cartoons while scanning their brains. Both genders rated 24 of the cartoons as funny, and when asked to rank them in terms of *how* funny they were, the genders again agreed. In addition, men and women had very little difference in their response times to the jokes they liked.

Given the sexes' similar capacity for humor production and appreciation, the fact that women laugh more—and men are laughed *at* more—must have its roots in something other than simply who is being funny. In fact, Provine's data support this idea, too: 80 to 90 percent of the statements that

## Eighty to 90 percent of the statements people laugh at are banal phrases such as “I’ll see you guys later!”

women,” Provine observes. This finding aligns with the idea that men are performing humor and women, the “selectors,” are appreciating it, but of course there are other possible explanations. Are women simply less discriminating when it comes to humor? Or are men the funnier gender?

### Cracking the Laughter Code

Recent research suggests these possibilities are unlikely. Men and women are consistently judged to be equally funny when they go head to head on humor production. For instance, in 2009 Kim Edwards, a Ph.D. student in psychology at the University of Western Ontario, asked men and women to come up with funny captions for single-frame cartoons. Both genders created an equal number of highly rated captions.

In humor appreciation, too, women and men are on equal footing. In 2005 psychiatrist Allan

elicited laughter in his field studies were not funny at all. Rather people laughed at banal phrases such as “I’ll see you guys later!” or “I think I’m done.” His research also showed that people tend to laugh more when they are speaking as opposed to listening. Many studies have confirmed this finding, and experts believe that when a speaker laughs, it sets his or her audience at ease and facilitates social connections. [For more on the general benefits of laughter, see “Laughing Matters,” by Steve Ayan; SCIENTIFIC AMERICAN MIND, April/May/June 2009.]

Provine found one notable exception to the rule that speakers laugh more than their audience, however: when a man is talking to a woman, the woman laughs more than the man. The difference is sizable: when Provine averaged laughter in two-person pairs, the speakers laughed 46 percent more than the person listening. When a woman was talking to another woman, she laughed 73 percent more than

DELCRUZ Retna Ltd./Corbis (Fey); GETTY IMAGES (Seinfeld cast)

# What's So Funny?

*A man walks into a bar with a priest, a rabbi and a duck. The bartender looks up and says, "What is this, a joke?"*

**A** bad one, perhaps. But telling formulaic jokes is only one of many ways to be funny. And men, it turns out, are much more likely to tell jokes than women are. Women make people laugh, too, but more often by sharing personal anecdotes. (Men: *that's what they're doing in the bathroom.*)

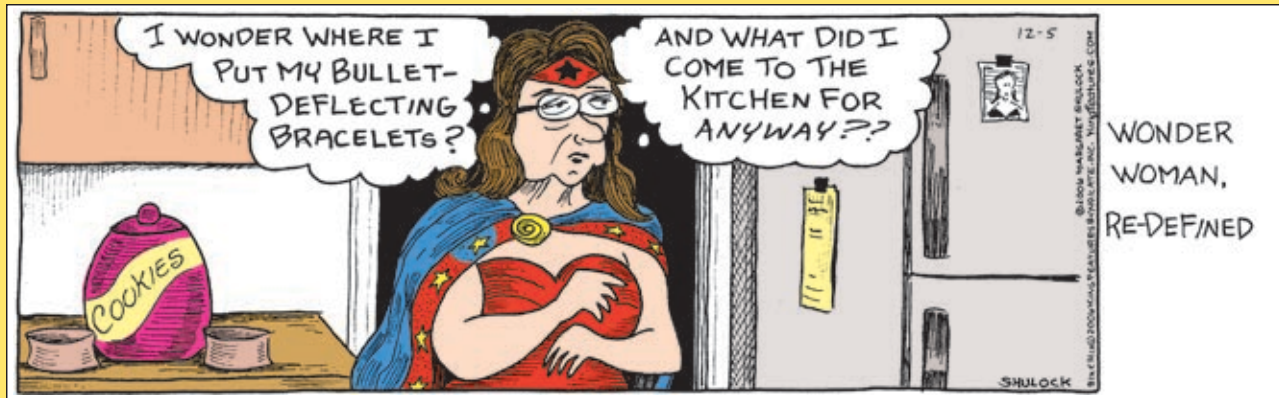
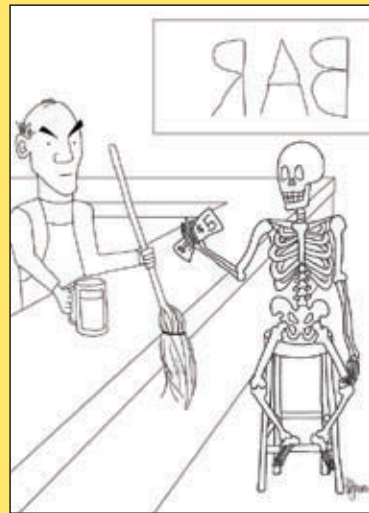
A glance at the funny pages makes the point. In 2007 psychologists Andrea Samson and Oswald Huber of the University of Fribourg in Switzerland analyzed cartoons from 61 countries and found that work by female artists (*example below*) tends to have more speaking characters than that of male artists (*right*), who are more likely to make absurd or abstract statements.

Psychologist Mary Crawford, now at the University of Connecticut, was one of the first to show this trend in real life. She surveyed each sex in 1991 and reported that men engage more with formulaic jokes, hostile humor and slapstick comedy—think of the classic Three Stooges plumbing short, rife with wrench blows to the head and dousings of water. Women, on the other hand, prefer to tell funny stories about real life—such as when Carrie of *Sex and the City* describes to her friends how her boyfriend broke up with her on a Post-it note.

The Post-it story is revealing because the event was quite sad, but it became funny in the self-deprecating retelling. Many studies show women tend to use this type of humor because it supports group solidarity—everyone can nod and think, "I've been there." (The cartoon by the female artist below is another good example.) Psychologist Jennifer Hay of Northwestern Uni-

versity noticed this trend in 2000 when she taped 18 group conversations in the lab. She reported a different style in men, who tended to tease and disparage more often—performing for the group and trying to one-up each other.

When men and women are together, however, there's a twist—the gender roles seem to reverse. Martin Lampert of Holy Names University and Susan Ervin-Tripp of the University of California, Berkeley, showed this style swap in 2006 by analyzing 59 real-life conversations. In mixed company, men teased significantly less and women teased more, specifically targeting their teasing at men. Men also tended to laugh at themselves more, whereas women became less self-deprecating. The researchers speculate that in these situations men may tone down their teasing lest they turn off a potential mate—and women may attempt to appear less vulnerable and assert equal standing with men. —C.N.



her interlocutor, but when a woman was in conversation with a man she produced 126 percent more laughter. Male speakers laughed less than female speakers, but they still laughed 25 percent more than their listeners when they were talking to other men. But in the specific circumstance where a man was talking to a woman, the men laughed 8 percent *less* than their partners.

The fact that women laugh so much when they

are speaking to men—and they laugh more than men even when the men are doing the talking—suggests that there is some instinct at play. Perhaps it is a reflection of the female role as sexual selector, but whatever the roots may be of the female instinct to laugh around men, it works—men find women attractive when they laugh. Perhaps it is because laughter unconsciously signals interest and enjoyment.

Consider that chimpanzees utter laughlike

COURTESY OF ERIC D. BAUM (top); ©MARGARET SHULOCK King Features (bottom)

## In long-term relationships it can sometimes be harmful for men to use humor. Timing is key.

sounds when they are being chased by other chimps, and as with human children, the one being chased is the one who laughs. For chimps playing, the panting laugh is a signal to the chaser that the play is fun and nonthreatening. The enjoyment might come from anticipation, as if the laughter is sending a message: I'm going to keep running, but it's going to be *really* fun when I get caught. Because women are the ones typically chased in courtship, could there be a link? "I think there's an interesting parallel there," humor expert Martin says. "In both cases, the laughter is a signal of enjoyment and invitation to continue."

Indeed, studies have shown that laughter is a powerful measurement of the level of attraction between two people. In 1990 psychologists Karl Grammer and Irenaus Eibl-Eibesfeldt of the Ludwig Boltzmann Institute for Urban Ethology in Vienna studied natural conversations in mixed-sex groups and measured the amount of laughter coming from men and women. Later on each individual self-reported how attracted they were to other members of the group. It turns out it is the amount of female laughter that accurately predicts the level of attraction between *both* partners. In other words, a woman laughs a lot when she is attracted to a man or

when she senses a man's interest—and that laughter, in turn, might make her more attractive to him or signal that she welcomes his attention.

### Funny through the Years

As attraction transitions to a relationship, humor's role changes, but sharing a laugh is no less important. Many agree it is the connection that humor fosters that makes it so good for relationships, especially over the long term. Humor often becomes a private language between two people. A couple's in joke can make a mundane or tense moment hilarious.

But here again, each gender's role is different—and interestingly, in some ways men and women change places. Unlike during courtship, when men are usually the humor producers and women are the appreciators, in long-term relationships it can sometimes be harmful for men to use humor. When women are the humorous partners, however, relationships tend to thrive.

Funny men are not necessarily a curse, of course, but in certain situations male humor might be dangerous. In 1997 psychologists Catherine Cohan of Pennsylvania State University and Thomas Bradbury of the University of California, Los Angeles,

When chimps play tag, the one being chased laughs, conveying pleasure and inviting more. A parallel in humans may be laughter during flirtation or teasing among friends, where it signals, "I'm okay with this; you can keep going."



FLPA/AGE FOTOSTOCK

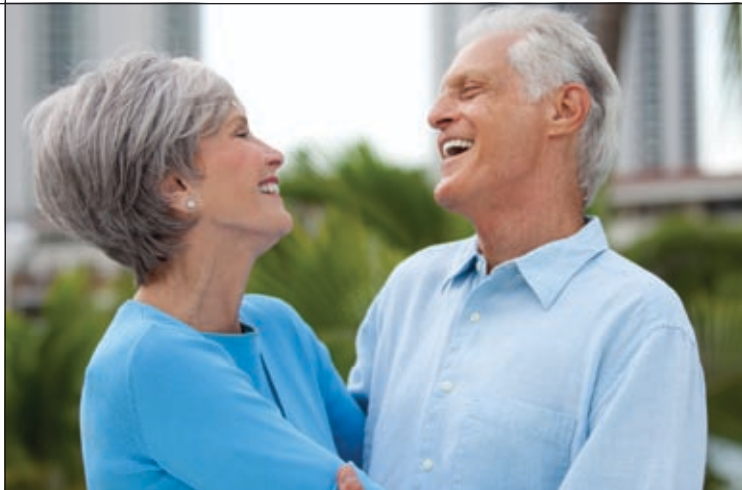
analyzed the marriages of 60 couples over an 18-month period, using data from self-reports and audiotaped conversations of the couples working through a specific marital issue. They found that in couples who had a major life stressor such as a death in the family or a lost job, the husband's use of humor during problem solving was a warning sign. These couples were more likely to wind up divorced or separated within 18 months than couples with a life stressor where the male did not use humor. This result may be about men knowing how and when to crack the tension with a joke. Timing is key. "Particularly with men's humor we see it used to avoid problems or serious conversations," Martin says. "And if it's used aggressively—in a teasing or put-down way—or at an inappropriate time, it can be detrimental to the relationship."

The idea that male humor might sometimes be bad for a relationship is supported by results from the Coping Humor Scale (CHS) test developed by Martin and psychologist Herbert Lefcourt of the University of Waterloo, which measures how much one uses humor to cope with life stress. They found in 1986 that men who score high on the CHS report less marital satisfaction than their peers who do not use humor as much to cope. They also discovered that men tend to use more disparaging forms of humor, directed at others, when coping with a tough situation. If this is the type of humor men are referring to when they take the CHS, Lefcourt notes, it might explain the lower relationship satisfaction.

Women, on the other hand, have been shown by many studies to often use self-deprecating humor, which may bring relief to a tense situation. [For more on types of humor each gender prefers, see box on page 43.] And the CHS study found that women who use more humor to cope reported greater marital satisfaction.

A recent physiological study may help explain why. Couples psychologist John Gottman of the Gottman Institute analyzed 130 couples discussing their top three most problematic issues. Starting when they were newlyweds, couples came to Gottman's lab once a year for six years and had private discussions while Gottman measured their physiological responses, such as blood pressure and pulse, with a polygraph and electrocardiogram.

Gottman found that the reduction of the male's heart rate during these intense discussions was critical for a successful marriage (whereas the women's heart rates made no difference). Some men were good at soothing themselves, but the next best way to lower these husbands' heart rates was for their wives to crack a joke to relieve the tension. Couples



in which the women deescalated the conflict in this way, according to Gottman, were more likely to have a stable marriage through at least the study's six years, as compared with couples in which the wives did not use humor.

As a relationship progresses, then, a man's humor becomes less important—perhaps even counterproductive in certain situations—whereas a woman's sense of humor becomes a blessing. During courtship, a man's wit attracts a woman, and her appreciative laughter, in turn, is attractive to him. But as commitment increases, the challenge becomes less about landing a mate and more about keeping one around. "Here it is more about sympathy and attunement to the other's feelings and perspectives," Martin says. "The goal is less to entertain and impress and more to reduce interpersonal tensions, convey understanding, save face for oneself and one's partner. Women may be more skilled at these uses of humor."

Of course, in real life men and women inhabit a wide spectrum, with far greater individual variation than is reflected in the trends that show up in the lab. Many people have traits that are the opposite of those normally associated with their sex. But in general, the way men and women use humor betrays its deeper purpose—to help us connect and bond with one another. A genuine laugh is one of the most honest ways to convey: I'm with you. **M**

**Wives who crack jokes during tough discussions can lower their husbands' heart rate and ease mounting tension.**

### (Further Reading)

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- ◆ **Production and Appreciation of Humor as Sexually Selected Traits.** Eric R. Bressler, Rod A. Martin and Sigal Balshine in *Evolution and Human Behavior*, Vol. 27, pages 121–130; 2006.
- ◆ **The Psychology of Humor: An Integrative Approach.** Rod A. Martin. Academic Press, 2007.
- ◆ **International Society for Humor Studies:** [www.hnu.edu/ishs/ConferCenter.htm](http://www.hnu.edu/ishs/ConferCenter.htm)



# Family Guy

Move over, “mommy brain.” Men go through their own biological changes after a baby is born. But dads are programmed to challenge their kids, not coddle them

**By Emily Anthes**

**M**ark Oppenheimer, a part-time stay-at-home father of two young girls, is used to stares. “When I’m walking down the street with one baby strapped to my chest and the other in a stroller—and the kids all look happy—and I walk by a group of mothers, they’re just blown away,” he says. “The easiest way in the world to get a smile is to be a man with a baby.”

Fatherhood has undergone a profound change in the past half a century. In 1965 fathers were spending 2.6 hours a week on child care; by 2000 that figure had reached 6.5 hours. There are three times as many stay-at-home fathers as there were a decade ago, and families headed by single fathers are the fastest-growing household type in the U.S. “When I started studying American mothers and fathers, the majority of the fathers I studied had never bathed their children. Many of them had never changed a diaper,” says developmental psychologist Michael Lamb of the University of Cambridge. That was in

the 1970s. “Now,” he says, “men would feel embarrassed to say they hadn’t changed their children.”

For years social scientists considered fathers to be second-string parents, bench players whose main role was to jump in when Mom was otherwise engaged. That view has changed, partly thanks to research revealing that dads are anything but backup mothers. Scientists are now turning to the nuances of how and why they matter. The work shows that fathers are biologically as responsive to their children as mothers are. And yet fathers seem to influence children in unique ways. In particular, they

CHRISTOPHER HUDSON/iStockphoto (family icon);  
PAUL BARTON Corbis (man and baby)







Dads relate to kids differently than moms do, tending more toward roughhousing than cuddling or coloring.

play an outsized role in challenging their kids and stretching their emotional and cognitive capabilities, preparing them for the big wide world.

### Partners in Play

In a 1958 paper British psychiatrist John Bowlby debuted a then controversial idea that became known as attachment theory: to develop properly, all children require a safe, secure relationship with

an adult, he claimed. He called his opus, “The Nature of the Child’s Tie to His Mother.” But some of the first studies to actually assess fathers, in the 1970s, found that dads are just as capable as mothers at caring for their children. Dads are equally able to interpret their infants’ distress as, say, a sign of hunger or fatigue and to respond accordingly. Men and women have the same physiological responses—changes in heart rate, respiration, skin temperature, and more—when they encounter fussy newborns. Just like mothers, blindfolded dads can pick their babies out of a nursery lineup merely by touching all the infants’ hands.

Research also shows that dads and dads-to-be go through many of the same physiological changes that pregnant women do. For example, in a study published in 2000 psychologist Anne E. Storey of Memorial University of Newfoundland in Canada and her colleagues found that expectant dads had elevated levels of prolactin, a hormone that is also sky-high in new mothers who are attached and responsive to their children. The researchers also discovered that the men’s testosterone levels dropped by about one third in the first few weeks after their kids arrived, a change that may make a man less aggressive and more nurturing. A follow-up study published in 2001 revealed that new fathers had lower testosterone levels than age-matched controls. Fathers can even suffer from postpartum depression: from a 2005 survey of 26,000 mothers and fathers, psychiatrist Paul G. Ramchandani of

#### FAST FACTS

#### Mr. Mom?

**1** Fatherhood has undergone a profound change in the past half a century. In 1965 fathers were spending 2.6 hours a week on child care; by 2000 that figure had reached 6.5 hours. There are three times as many stay-at-home fathers as there were a decade ago.

**2** For years social scientists considered fathers to be second-string parents, but that view has changed, partly thanks to research revealing that dads are anything but bit players in their children’s lives. Fathers are biologically as responsive to their children as mothers are.

**3** Fathers influence children in unique ways. In particular, they play an outsized role in stretching their emotional and cognitive capabilities—enriching their verbal skills, for example, and encouraging them to take risks.



An infant picked up by his mother will calm down. When picked up by Dad, the child's heart rate jumps, a sign that Junior's getting excited.

the University of Oxford determined that 4 percent of fathers had symptoms of depression within eight weeks after their children were born. Fatherhood can alter the brain in other, more positive ways as well [see box on page 51].

But although parenting is just as biologically natural a role for men as it is for women, fathers typically interact with their kids in a way distinct from that of mothers. In traditional two-parent households, moms tend to provide most of the care and comfort to infants, whereas dads are more likely to play with them. "Fathers spend proportionally more of their time engaging in play with kids, which tends to be highly arousing and usually quite positive," Lamb says. Classic studies conducted in the 1970s and 1980s show this discrepancy is pervasive in the U.S. And in a 2006 assessment Lyn Craig, a senior research fellow at the University of New South Wales's Social Policy Research Center, and her colleagues found that Australian fathers spend about 40 percent of their child care time engaging in interactive activities such as play or reading as compared with 22 percent in the case of mothers.

By eight weeks old, babies have noticed this pattern. An infant picked up by his mother will calm down, showing decreases in heart rate and respiration. When Dad picks up his child, however, the child's heart rate and respiration increase—a sign that Junior's getting excited for a rollicking game.

One reason for fathers' particular playfulness may lie in the traditional division of labor in American families. In her study, Craig found that 51 percent of mothers' child care time—but only 31 percent of fathers'—is spent performing physical and emotional care such as feeding, bathing, cuddling and soothing. If mothers are doing the bulk of the caretaking, fathers have the luxury of goofing off with Junior. Note that these differences are proportional and do not mean that men spend more total time playing with their children. In fact, a second reason for fathers' emphasis on play may stem from the fact that they tend to be around their children less than mothers are. "If you had a young child and only had an hour to be with that child, you might tend to use that time to have a lot of fun, to play a lot," says Catherine Tamis-LeMonda, a psychologist at New York University.

Cultural comparisons support the notion that

the division of labor drives some of this parenting behavior. In cultures in which men take on more child care—such as the Aka foragers of Central Africa, a society in which fathers are equal partners in caregiving—they spend less of their time in play. And in the U.S., cultural norms regarding masculinity may also contribute, making some men more comfortable rolling a truck on the floor than rocking their infants to sleep. So although dads are biologically wired to take on any aspect of parenting, for cultural reasons they often end up carving out their own niche within that multifaceted job.

### Taking Chances

Fathers also have different play styles than mothers do. An accumulation of studies now shows that fathers tend to engage in more physical play than mothers do. In 1986 researchers asked the parents of more than 700 children how they played with their kids. The results showed that dads are more likely than moms to bounce their kids on their knees, toss them into the air, give them piggyback rides, and wrestle, tickle and chase them. Moms, on the other hand, generally opted for less energetic games, such as patty-cake, with their little ones.

In his 2009 book, *Children, Play, and Development* (fourth edition, Sage Publications), psychologist Fergus P. Hughes, an emeritus professor

Mothers spend just 22 percent of their time with children in interactive activities such as reading, playing or drawing. Fathers spend 40 percent of their time with kids that way.



CORBIS



## Together two parents may strike a nice balance in which Mom acts as a “lifeguard” and Dad functions as a “cheerleader.”

Dads often encourage their kids to take physical risks, helping prepare them to tackle challenges as they grow.

at the University of Wisconsin–Green Bay, reviews other peculiarities of fathers’ play. Moms are more likely to engage in verbal play—singing songs or rhymes, for instance—as well as to use toys and play conventional games. When fathers do use toys, they are often inventing new ways of using them or integrating them into new games. Men also have less predictable play patterns, peppering children with surprises that may boost cognitive development.

In addition to promoting highly physical frolicking, dads encourage kids to take physical risks. In a study published in 2007 Tamis-LeMonda and her colleagues presented the parents of 34 infants with an adjustable ramp. Each mother and father was independently asked to position the ramp to the steepest slope he or she thought the child could crawl down. Most mothers and fathers overestimated their children’s abilities (as it later turned out when the babies were put to the test). But when parents were asked to create the steepest slope they would permit their baby to crawl down if they were

across the room, 41 percent of fathers would allow their children to tackle a ramp that was even steeper than the one they had set up in the first part of the experiment. Only 14 percent of mothers were willing to similarly challenge their kids.

Complete safety should not always be the dominant priority in parenting, Tamis-LeMonda points out. “In the physical motor domain, that might be one of the functions of dads—to challenge kids a little more,” she says. Together two parents may strike a nice balance, she adds, in which Mom acts as a “lifeguard” and Dad functions as a “cheerleader.”

A father’s predilection for training his kids to be physically tougher and more daring suggests to some researchers that fathers open kids up to new experiences to help prepare them for future life challenges. A neat bit of research from 1995 encapsulated this idea. While studying the behavior of parents who had enrolled their one-year-olds in an infant swimming class, investigators found that fathers tended to hold their babies so they faced out



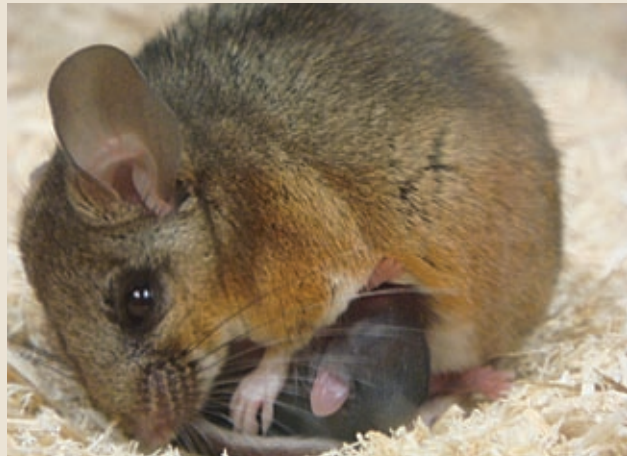
PHILIP AND KAREN SMITH age fotostock

# The Daddy Brain

**G**iving birth to, and caring for, offspring has been known to give mother animals a boost in certain cognitive domains, making them more efficient foragers, for instance. But recent research suggests that such benefits are not limited to mothers. In unpublished work, behavioral neuroscientist Kelly Lambert of Randolph-Macon College and her colleagues tested the mental skills of father and bachelor California deer mice, a species in which males naturally pitch in as caregivers. Compared with bachelor rodents, the fathers were better foragers—quicker to learn where food was located in a maze—the researchers found. The dad mice were also more comfortable in strange situations, showing less stress around novel stimuli.

These behavioral differences seemed to be rooted in the fathers' brains. Lambert's team found more cellular changes in the hippocampus, a brain region involved in learning and memory, in the fathers' brains than in the bachelors' brains. What is more, the brains of father mice—as well as those of foster fathers, who each cared for another male's pup for several days—contained more nerve fibers that were sensitive to oxytocin and vasopressin (hormones associated with caregiving behavior) than did males that had had no exposure to pups.

Other data hint that similar cognitive enhancement may occur in primate fathers. In 2006 scientists working in the laboratory of neuroscientist Elizabeth Gould of Princeton University reported that when marmoset monkeys became fathers, neurons in the prefrontal cortex, a brain region dedicated to planning and decision making, became more densely



**Male California deer mice not only care for their own pups but also will nurture others' offspring, as this father mouse is doing. Being a dad pays back, too: it boosts brainpower in these rodents.**

connected and sprouted more receptors for vasopressin, suggesting an increase in the area's cognitive capacity.

The behavioral and biological changes seen in rodent and primate fathers are similar to those researchers have observed in mammalian mothers. But studying fathers is important—and not only because their biology differs at least subtly from that of their female counterparts. In mothers, researchers must untangle the effects of pregnancy from those of caregiving. Says Lambert: “The males are a purer model of parental behavior.” —E.A.

into the water, whereas the mothers stood in front of their children, establishing face-to-face contact.

## Language Lessons

In addition to emotionally preparing children for new challenges, fathers help bolster their cognitive capacities—in particular, their verbal skills. In a 2006 study psychologist Lynne Vernon-Feagans of the University of North Carolina at Chapel Hill and her colleagues studied family triads—two-year-olds in free play with both their mothers and their fathers. They found that the fathers were far less verbal with their children, speaking fewer words and taking fewer conversational turns than the mothers. And yet the researchers found that fathers' language use—but not mothers'—independently predicted their children's language development at age three. The larger the variety of word roots that fathers used with their two-year-old children—where, for instance, “talk” and “talked” were counted as a single word root—the better the kids

scored on a standard test of expressive language a year later. The size of a mother's vocabulary seemed to have no effect on children's scores.

Fathers' influence may stem from the different way in which they talk to their children. In a not yet published follow-up study, Vernon-Feagans discovered that fathers use more unusual words than mothers do when speaking to their kids. “Mothers use more emotion words. ‘Oh, did you hurt yourself? Are you hungry?’” she says. “Their words aren't as complex as the dad's words. Fathers' approach is more talking about sports and cars and other unusual subjects.” This finding jibes with earlier research suggesting that mothers are more likely to “talk

## (The Author)

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down” to their children, according to their perception of a child’s linguistic abilities. Dads, on the other hand, may be less sensitive to their children’s language skills (perhaps because they spend less time with them) and are therefore more apt to stretch them, speaking at a more sophisticated level.

Indeed, in a study published in 2004 psychologist Meredith Rowe, now at the University of Maryland, and her team showed that fathers in low-income families asked their toddlers more “who,” “what,” “where” and “why” questions and made

might disproportionately influence children’s linguistic development. Of course, fathers may also end up being more important in language development because their involvement is more likely to vary, and numerous studies have shown that the absolute amount of language a child is exposed to—that is, how much adults talk or read to them—has a powerful effect on the child’s verbal development.

Dads themselves may not realize how much influence they have, so they may duck out of parenting when they don’t feel like it. But an absence of father-



## Kids who have stable and involved dads are better off on nearly every cognitive, social and emotional measure researchers can devise.

more requests for clarification from their children, perhaps because they had more trouble understanding their children than mothers did. In response, these toddlers ended up using longer utterances and larger vocabularies when talking to their fathers than to their mothers.

Exposure to complex speech does positively influence language development in children. In a 2002 investigation psychologist Janellen Huttenlocher and her colleagues at the University of Chicago noted a connection between the syntactic complexity of a child’s speech and that of his or her parents: differences in children’s mastery of multiclausal sentences paralleled the proportion of multiclausal sentences in parent speech. Thus, if fathers are using more complex grammar and vocabulary than mothers, they

ing has a measurable effect on the children. In a study of new parents published in 2009 psychologist James Paulson of Eastern Virginia Medical School and his colleagues assessed 4,109 two-parent families to determine how depression influenced how often the parents read to their children. Fathers and mothers who were depressed when their children were nine months old read to their tots less often than nondepressed parents did. For mothers, however, the decline was minimal and did not affect a child’s language development. But in depressed dads, the decrement was larger and had an impact. The less that fathers read to their infants, the worse their toddlers scored on a standard measure of expressive vocabulary at age two. “It may be that when dads were depressed, they had the flexibility to withdraw more. And because of that, their depression had more impact on their parenting and more impact on their child’s language,” Paulson says.

Moms who have low self-esteem tend to dismiss or criticize dads’ parenting attempts more often than self-confident moms do.

### Letting Dad Parent

Kids who have stable and involved dads are better off on nearly every cognitive, social and emotional measure researchers can devise. For instance, high levels of father involvement are associated with children who are more sociable, confident and self-controlled and less likely to act out in school or engage in risky behaviors in adolescence. Men such as Oppenheimer who share parenting duties with women derive more satisfaction and pleasure from their paternal role, and women whose male partners take on a fair share of the child care have higher marital satisfaction, are less stressed, and have more positive views about their children.



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In many cases, psychologists say, mothers are behind Dad's involvement—or lack of it—as much as or more than fathers are. That is, mothers hold a lot of power to shape not only their own relationships with their kids but those between the kids and their father. Sometimes they use that power to block fathers' participation by acting as informal “gatekeepers” to their children. For instance, moms may bond so strongly with their children that they leave little room for dads or are so anxious about the way their children are raised that they need to maintain complete control. Or some women simply want home to be their place of authority and power.

In fact, research has shown that women with low self-esteem are more likely to act as gatekeeper, suggesting that parenting can be a source of validation for these women. In a study published in 2008 social psychologist Ruth Gaunt of Bar-Ilan University in Israel and her colleagues visited the homes of 209 couples with small children and asked each mother and father to complete a questionnaire assessing parenting behaviors and values as well as various personality traits. The investigators associated the tendency to be a gatekeeper with certain psychological traits of the mothers. In particular, mothers who scored low on a standard measure of overall self-esteem were more likely to agree with statements such as “My husband doesn't really know how to take care of our child, so it's just easier if I do these things” and “Most women enjoy caring for their homes, and men just don't like that stuff.”

But Mom's attitude toward Dad's parenting can influence the man's contribution in either direction. In a 2008 study psychologist Sarah Schoppe-Sullivan of Ohio State University studied 97 couples after their first children were born. Schoppe-Sullivan found that in families in which the mothers engaged in behaviors critical of fathers—by, say, rolling their eyes or making a face in response to their partner's parenting attempts—dads did less child care. But when mothers encouraged fathers—by telling men that they made their babies happy or by seeking out their opinions on parenting questions—the dads had significantly higher levels of involvement.

What is more, allowing dads to do a considerable amount of caretaking in the first days of a child's life can have even more lasting benefits. Numerous studies show that fathers who are involved when their child is an infant are more likely to remain active parents years later. In a classic report from 1980, psychologists examined the fathers of children born via cesarean section; because these mothers are briefly out of commission, their male partners end up doing more infant care in the first



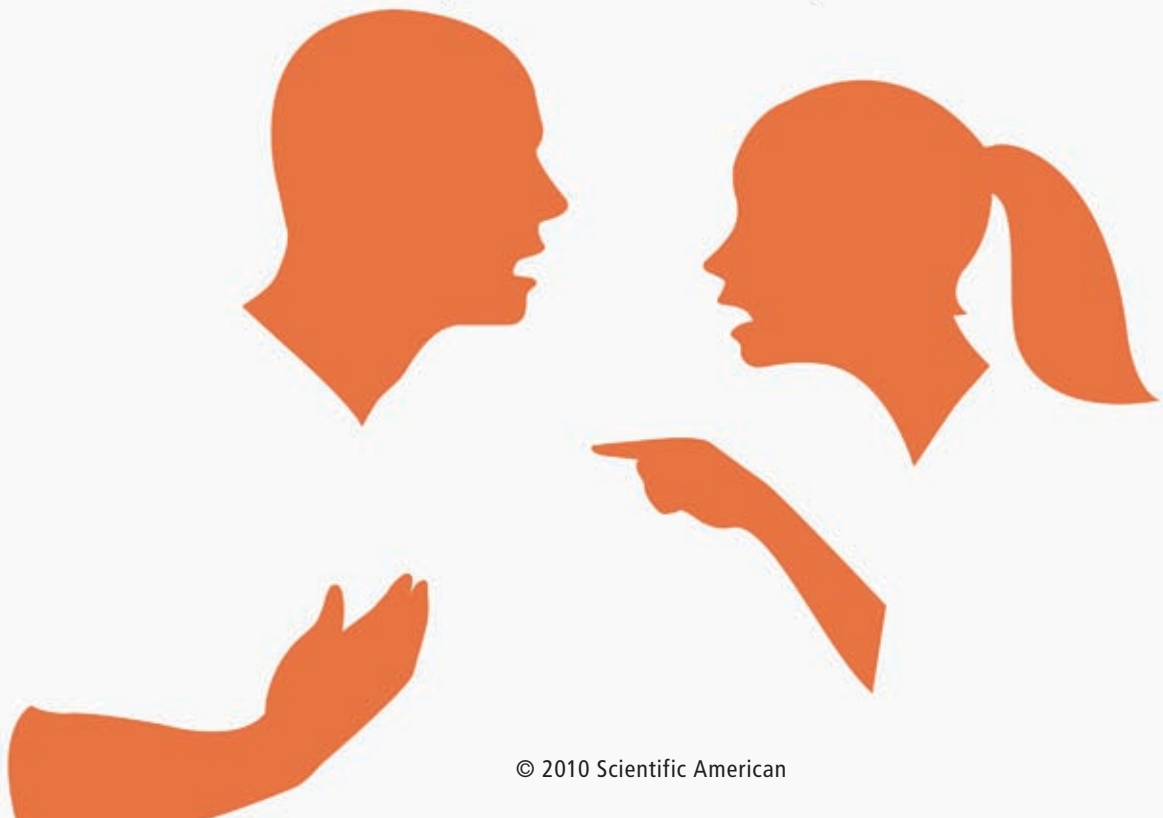
few days after birth. Months later the dads were still more involved with their babies than were men whose partner did not have a C-section.

Understanding the unique characteristics that dads bring to the changing table can not only improve the family dynamic but can also help us identify the variety of influences that children require for healthy development. Kids clearly need what dads do, but that does not mean that men must be the only ones to provide those things. If we understand how fathering is and is not like mothering, we can ensure that children get the full complement of influences—such as sensitive care and arousing play—that they need to develop into happy, successful adults. **M**

**When a father does a lot of child care early on, he is more likely to be an active parent in later years, too.**

### (Further Reading)

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# HE SAID, SHE SAID,

Women and men speak their own languages, but research reveals the conversational gender divide is not as stark as it seems

By Deborah Tannen

**W**hy don't men like to stop and ask directions? This question, which I first addressed in my 1990 book *You Just Don't Understand: Women and Men in Conversation*, garnered perhaps the most attention of any issue or insight in that book. It appeared on cocktail napkins (“Real men don’t ask directions”) and became a staple of stand-up comics as well as jokes that made the rounds: “Why did Moses wander in the desert for 40 years?” and “Why does it take so many sperm to find just one egg?”

The attention surprised me. I had not known how widespread this experience was, but I included the asking-directions scenario because it crystallized key aspects of a phenomenon that, I had discovered, accounts for many of the frustrations that women and men experience in conversation. I have spent more than three decades collecting and analyzing thousands of examples of how women and men interact and have found that men’s talk tends to focus on hierarchy—competition for relative power—whereas women’s tends to focus on connection—relative closeness or distance. In other words, a man and woman might walk away from the same conversation asking different questions: he might wonder, “Did that conversation put me in a one-up or one-down position?”

whereas she might wonder, “Did it bring us closer or push us farther apart?”

But wait! All conversations, and all relationships, reflect a combination of hierarchy and connection—the two are not mutually exclusive but inextricably intertwined. All of us aspire to be powerful, and we all want to connect with others. Since the publication of *You Just Don't Understand*, I have continued to investigate the nuances of women’s and men’s ways of speaking to clarify how their conversational styles are different ways of reaching the same goals. My newest work explores the context in which *women’s* focus on hierarchy and *men’s* on connection is most obvious and most intense: the family. In particular, sisters provide insight into relationships among women that are deeply

influenced by competition as well as connection.

So what does any of this have to do with asking for directions? The route to the answer may not yet be obvious, but read on and I promise to get you there.

## “Mine’s Higher” vs. “We’re the Same”

My interest in the linguistic differences between women and men grew from research I conducted early in my career on conversations between speakers of different ethnic and regional backgrounds. These interactions often led to misunderstandings because members of each group had contrasting assumptions about what should be said and the appropriate way to say it. I sensed, and later showed, a parallel pattern in conver-

sations between women and men—a gender-based culture clash.

I often illustrate—and trace—this phenomenon using video clips of preschoolers at a day care center. In one scene, four little boys are sitting together, talking about how high they can hit a ball. “Mine’s up to there,” one small boy declares, raising his arm above his head. “Mine’s up to the sky,” a second responds, pointing higher. A third boy counters, “Mine’s up to heaven!” Then the fourth boy offers: “Mine’s all the way up to God.” These boys’ verbal exchange is obviously a game of hierarchy, as each one’s claim tops the preceding one.

I contrast this video clip with another from the same preschool: two little girls are sitting at a small table, drawing. One girl suddenly raises her head, looks at the other, and says (apparently referring to contact lenses), “Did you know that my babysitter, called Amber, has already contacts?” The second girl looks puzzled at first but quickly gathers herself together and announces, with ap-

Boys and men often try to top each other, a tendency that emerges in conversation as a kind of verbal sparring.

parent relish, “My mom has already contacts and my dad does, too!” The first girl laughs with glee at this echo response, which even matches the first girl’s odd syntax (“has already” rather than “already has”). After a pause, during

which both girls return to drawing, the first one exclaims with delight, “The SAME?!” Being the same is as pleasing to her as topping one another is to the boys.

Although the specific conversational moves—topping versus matching—are different, what these contrasting conversations have in common is that they are rituals: self-evident assumptions about how the conversations should go and what a reasonable remark or response should look



“Mine’s up to there,” one small boy declares. “Mine’s up to the sky,” a second responds, pointing higher.

like. As with cross-cultural communication, we do not recognize them as rituals until we talk to others who do not share our assumptions.

Parents tell me that recognizing these as gender-related patterns in their children helps them deal with otherwise baffling behavior. For example, a woman recalled overhearing three little boys—her son and two of his friends—talking in the backseat as she was driving. One boy said, “When we went to Disneyland, we stayed three days.” The second boy said, “When we went to Disneyland, we stayed four days.” Then her son said, “We’re going to move to Disneyland!” She was troubled to hear him utter an obvious untruth. Should she instruct her son not to tell lies? I assured her that the boys knew that her family was not going to move to Disneyland. But her son won that round.

A father told me about a similar confusion upon overhearing a conversation between his little girl and her friend. The friend had said, “I have a brother named Benjamin and a brother named Jonathan.” His daughter responded, “I have a brother named Benjamin and a brother named Jonathan, too.” But she didn’t. Her father wondered why she would say such a thing. I explained that she was simply offering a matching experience as a sign of goodwill, to reinforce the friendship.

The contrasting focus on connection versus hierarchy also sheds light on innumerable adult conversations—and frustrations. Say a woman tells another about a personal problem and hears in

#### FAST FACTS

### Genderspeak

**1**» Men’s talk tends to focus on hierarchy—competition for relative power—whereas women’s tends to focus on connection—relative closeness or distance.

**2**» But all conversations, and all relationships, reflect a combination of hierarchy and connection. The two are not mutually exclusive but inextricably intertwined. All of us aspire to be powerful, and we all want to connect with others. Women’s and men’s conversational styles are simply different ways of reaching the same goals.

**3**» The context in which women’s focus on hierarchy and men’s on connection is most obvious and most intense: the family. In particular, sisters provide insight into relationships among women that are deeply influenced by competition and hierarchy as well as connection.

response, “I know how you feel” or “the same thing happens to me.” The resulting “troubles talk” reinforces the connection between them. (Indeed, some women feel they have to dig up problems to tell friends to maintain intimacy.) Because this is not a conversational ritual he is used to, a man may well misread her conversational gambit as a request for help solving the problem. The result is mutual frustration: she blames him for telling her what to do and failing to provide the expected comfort, whereas he thinks he did exactly what she requested and cannot fathom why she would keep

lack self-esteem if he has to throw his weight around like that.

Which takes us back to the woman and man in the car who have different assumptions about asking directions. From her point of view, asking directions means making a fleeting connection to a stranger and getting where you are going without losing anything. From his perspective, he would be putting himself in a one-down position to a stranger—an uncomfortable experience. He might even believe the effort is counterproductive because a stranger who does not know the way will be similarly motivated by a reluctance to appear one-down and send them on a wild-goose chase. For both reasons, it makes sense to avoid this discomfort and spend 10 minutes—or 20 or 30—finding the way on his own.

### Different Styles, Similar Goals

Despite these differences, women’s and men’s conversational

styles are more alike than they may appear. Although these styles may seem opposite, they can be used for similar purposes. Boys and men are also concerned with connection, and girls and women with power, even as they may have different ways of pursuing these goals.

Verbal rituals that focus on connection often involve affirming sameness, as we saw in the little girls’ exchange about contact lenses and in the familiar responses: “The same thing happened to me” and “I’m the same way.” Yet the contrasting ritual, “That’s nothing! Here’s what happened to me...,” which is typically associated with men—and interpreted as competitive—can also create connection, by implying, “You shouldn’t feel bad about what happened to you, because what happened to me was worse.” In other words, “topping” each other can be another way to commiserate.

Similarly, for girls and women, what

**Recognizing these gender-related patterns can help parents deal with baffling behavior in their kids.**

appears on the surface to be aimed at connection can also be a way to exert power. Linguist Amy Sheldon of the University of Minnesota has investigated this process by videotaping preschool children playing in same-sex groups of three. She found that both boys and girls pursued their own goals, but whereas the boys she taped were obvious about thwarting another’s goals, the girls often did so in ways that appeared to honor the other girls’ goals as well. In one example, two girls, Eva and Kelly, were not eager to include the third girl, Tulla, in their play. Instead of telling Tulla outright that she could not play, they included her but assigned her a role that precluded her participation: “You can be the baby brother, but you aren’t born yet.” Sheldon emphasizes that this is a highly assertive move, even as it maintains the appearance of accommodating Tulla’s wish to be part of the game.

In this instance, the children’s behavior is not a clear on-or-off application of hierarchy or connection but a blending of both. We could say that Eva and Kelly exercised power to keep Tulla from participating but also honored the connection by assigning her a role. In contrast, Sheldon observed that when boys played, they tended to insist more overtly on their own goals and even to



Girls and women like to match. When they talk, they emphasize their similarities to build intimacy.

talking about a problem if she does not want to do anything about it.

Similar scenarios play out at work, where mutual misinterpretations may have career-altering consequences. For example, if a woman’s boss overhears her telling a subordinate, “Could you do me a favor and get me a copy of that report?” he may think she lacks confidence. It appears to him as if she does not feel she has a right to ask her subordinate to do something. But the truth is probably the exact opposite. She knows the subordinate has to do what she asks. Her locution “do me a favor” is simply a way of not flaunting the power she obviously has—and thus saving face for the subordinate. If men often mishear women’s ritual indirectness as lacking confidence (or even competence), women often misinterpret *less* indirect rituals as overbearing—and also lacking in confidence. Her thinking goes: he must really

### (The Author)

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threaten physical force. For example, when one boy, Nick, wanted to cut a plastic pickle that another boy had, he screamed, “I *have* to cut! I want to cut it! It’s mine!” Sheldon stresses, however, that although boys and girls tended to use more of one strategy or another, the difference was not absolute but of degree. Boys did sometimes attempt to compromise, and girls did at times attempt physical force to get their way.

**In a typical casting setup for a family play, an older sister might say, “I’ll be the princess; you be the frog.”**

Sheldon’s research reminds us that patterns, no matter how real, are never absolute. Again, the asking-directions example is instructive. I didn’t realize how common that scenario is because my husband does stop and ask directions, whereas I am the one who says, “I’d rather find it myself on the map.” In this respect, he and I are not typical, as many of us are not typical of our genders, cultures, regions or any other group to which we belong.

Gender differences are a matter of relative *focus* on connection and hierarchy, as we all want to accomplish both goals to some extent. We are always engaged in negotiations over connection and relative power. Eva and Kelly served both goals when they included Tulla—and kept her from participating. Similarly, the boys who verbally competed about how high they could hit a ball also created connection by agreeing on the type of verbal game to play. To understand gender patterns, then, rather than asking, “Does this way of speaking serve hierarchy or connection?” we need to ask, “How does this way of talking reflect the

interplay of connection and hierarchy?” And nowhere can this interplay be better explored than in the context that is both universal and fundamental: the family.

### Family Ties

Family comes with built-in hierarchy as well as built-in connection. The hierarchy between parents and children is self-evident, but the same is true of siblings. Even though we use the phrases “like sisters” or “like brothers” to describe friendships that are close and equal, actual sibling relationships are defined not only by the connection of shared family but also by the hierarchy of birth order. I have been particularly intrigued by sisters—not only because I have two, but, most important, because in sisters we see a relationship between women that is deeply competitive and hierarchical.

In *Having Our Say*, the Delany sisters’ 1993 best-selling memoir, Bessie Delany is quoted as saying, “Sadie doesn’t approve of me sometimes. She looks at me in that big-sister sort of way.” When she said this, Bessie was 101, and Sadie was 103. Elsewhere in the book, Sadie says, “If she lives to 130, I’ll just have to live to 132, so I can take care of her.” Their relationship was shaped more by the two years separating them than by the century they had lived.

These centenarians’ comments reflect dynamics I heard from many of the more than 100 women I interviewed about their sisters for my book *You Were Always Mom’s Favorite!: Sisters in Conversation Throughout Their Lives*, as well as comments I have heard about brothers: older siblings were often seen as protective but also judgmental. After all, these qualities are two sides of the same coin. “Judgmental” means you see how others can improve themselves and their lives—and tell them. We all often think of ways our friends, relatives and even strangers could do things better. But we usually don’t tell them what we think—unless we feel responsible for them. Parents often come across as judgmental to children because they feel

it is their right, if not their obligation, to make sure their children’s lives go as well as possible, which means letting them know the ways they can improve. Such offers of advice, however, no matter how well-meaning (in other words, focused on connection), are typically heard as criticism—and therefore as put-downs. The giver of advice is one-up, superior in knowledge and, by virtue of exercising the right to tell the other what to do, also superior in rank.

Similarly, many older sisters speak to younger siblings with commanding and unambiguous authority—ways of speaking that are more often associated with boys and men. One woman told me when she was small, she and her older sister played a game they called “mop.” She was the mop. Her sister would grab her by the feet and drag her around the house, her long hair sweeping the floor like a mop. Several other women recalled their older sisters organizing and directing plays. A typical casting setup was:

“I’ll be the princess; you be the frog.” In my own family, my father overheard me ask my sister,

**Older sisters often act dominant to younger sisters, speaking to them in ways more often expected of boys and men.**



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Men may resist asking for directions because the act puts them in a one-down position to a stranger.

**Sisters may compete about who knows more personal information. Brothers may compete about who knows more facts.**

connection built into their relationship by virtue of shared family. Sisters and brothers tend to vie, however, for dominance in different arenas. Sisters may compete about who knows more personal information about family members, whereas brothers may compete about who knows more facts about impersonal information such as computers or history.

Family relationships make clear that closeness is not opposite or even distinguishable from hierarchy and competition. Indeed, one reason that older sisters feel so comfortable bossing younger ones around and giving them advice is precisely because there is a strong connection between them. In addition, the deep love between older and younger siblings, like that between parents and children, results in part from the acts of caretaking and the experience of being taken care of that these roles entail.

Listening in on conversations among family members reveals a unique blend of authority and intimacy in talk among women as well as among men. It highlights the ways in which gendered conversational patterns can be different routes to the same goal: finding the right balance of closeness and distance while simultaneously negotiating relative power. **M**

when I was about four and she about six, “Mimi, can I play in your backyard?” Clearly, I did not question the authority that my older sister had assumed in her dealings with me.

At the same time, closeness is the holy grail of sister relationships, as it tends to be for girls and women in other contexts as well. When speaking to women about their sisters, I often heard “I wish we were closer,” but never “I wish we weren’t so close.” Their comments also generally reflected the assumption so common among women that troubles talk is critical for intimacy. Women told me they were deeply hurt to learn that a sister had kept important personal information secret. Whereas a brother (or a father) might say, “He told us when he was ready,” sisters (like mothers) often feel, “I thought we were closer than that.”

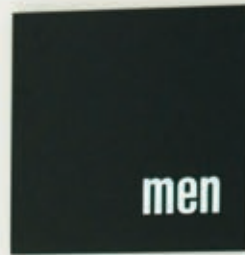
A powerful rivalry often accompanies sisterly ties—but it can take the form of competition for connection. Sisters often feel acutely competitive about who knows what about family members’ secrets—or who knows what first. The

20/20 correspondent Juju Chang, in a segment of the show based on my book, explained that she and her three sisters have learned that if one of them has important personal information to impart—news of an engagement or a pregnancy, for example—they must set up a conference call so all three sisters will learn the news at the same time. Otherwise, the sister who is called first will seem to be favored, and the others will feel slighted.

Thus, sisters are often very competitive, and hierarchy is built into their relationship by virtue of birth order. And brothers are often very close and have

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# The **Third** Gender

Transsexuals are illuminating the biology and psychology of sex—and revealing just how diverse the human species really is **By Jesse Bering**

**T**he reigning queen of Belfast, Northern Ireland, is the “Baroness” Titti Von Tramp, a deeply bronzed, thoroughly waxed and statuesque figure approaching seven feet tall in stiletto heels, wearing tinted couture glasses and crowned with a perfect platinum mane. On any given night, you can find the bosomy Von Tramp at one of the local nightclubs, pursing her strawberry-colored lips in a photo-op for one of her many fans or perhaps making an Ulster businessman turn bright red by deviously running one long, manly finger down the man’s cheek and judging, “That’s a good year.”

For many people, the term “transvestite” is synonymous with such larger-

than-life characters, an entertaining coterie of mostly gay men and their over-sexed female alter egos. But as with any human demographic, transvestites are a very diverse bunch, and it is only a select few who can turn their minority status into such a lucrative career in drag theatrics. For more modest individuals, the limelight is hardly a desirable place to be. Furthermore, the psychological motivation to dress or act as the opposite sex varies widely—transvestism is but one of the many manifestations of cross-gender behavior in the human species.

As researchers probe the biological, psychological and cultural underpinnings of transsexuality in its myriad forms, they continue to be astounded by

the individual variation they find. And many scientists believe that this incredible diversity offers an important opportunity to unravel the subtle threads tying together biological sex, gender and sexual orientation. In fact, it is only because these traits occasionally fail to match up along predictable lines in a single individual that scientists fully realize how very distinct these variables are from one another.

### Gender vs. Sex

Biological sex is perhaps the most straightforward of the three variables at the heart of the science of transsexuality. We all have a set of sex chromosomes that identifies each of us either as a genetic male (XY) or as a genetic female (XX). Of course, as we learned from the recent case of Olympic runner Caster Semenya, a woman rumored to have a genetic abnormality that gave her body malelike strength, chromosomal sex is not always so obvious. There are many genetic disorders in which sex chromosomes are either missing or redundant (for example, XYY), and birth defects can occur in which infants are born with ambiguous genitalia. But in general, researchers who study gender identity disorder—the clinical term for what we colloquially know as transsexuality—exclude individuals with underlying chromosomal or somatic abnormalities such as the one rumored to affect Se-

menya. Transsexuals are people with normal chromosomes—biological males or females—who feel, psychologically, like the opposite sex.

This brings us to the concept of gender, which is meaningfully different from biological sex. Gender identity is a subjective feeling of “maleness” and “femaleness.” In most cases, biological (genetic) males have a male gender identity, and biological females have a female gender identity. When a disconnection occurs between a person’s biological sex and his or her gender identity, however, an uncomfortable gender dysphoria can arise. This persistent negative emotional state is often a factor in the decision to undergo sex reassignment surgery,



which many transsexuals choose to do.

The third variable related to sex and gender is sexual orientation. Most biological males are attracted to biological females, and vice versa. Yet the very fact that homosexuals (and bisexuals) exist—and, more important, are represented by such a wide, stereotype-shattering spectrum of individuals that includes both “lipstick lesbians” and very masculine gay men—shows clearly that sexual orientation, too, is separable from both biological sex and gender identity. It is worth pointing out that homosexuality itself is not a transsexual behavior—gay men, in general, do not want to become women—but transsexual people can be either straight or gay.

#### FAST FACTS

#### When Gender and Sex Do Not Align

- 1**» Transsexuality manifests itself in many forms. The underlying psychology varies, but most transsexuals feel an unhappy mismatch between their biological sex and their gender identity.
- 2**» By studying transsexuality, scientists have realized that biological sex, gender identity and sexual orientation are three distinct, independent variables.
- 3**» Culture also influences who becomes a transsexual—and not always in expected ways. In traditional cultures, for example, people may turn to transsexuality as a way to conform to social norms.

In teasing apart these three related but distinct constructs of biology, gender and sexual orientation, scientists are starting to better understand the phenomenon of transsexuality, a term defined by the American Psychological Association as “a strong and persistent cross-gender identification and a persistent discomfort with [one’s] biological sex.” Their findings are revealing that even within the transsexual community there is much diversity. For example, a biological male who experiences gender dysphoria, and thus “feels” like a female, can be either gay or straight when it comes to his sexual orientation. And beyond the mixing and matching that occurs between sex, gender and sexual orientation, a huge array of psychological and cultural factors seems to underlie or affect transsexuality. Scientists are only starting to unravel these seemingly innumerate influences.

### Mind over Gender

Although mental states can differ widely among transsexuals, most report experiencing gender dysphoria—the unhappy mismatch between biological sex and gender identity. A good example of gender dysphoria is the case of Chaz, formerly Chastity, Bono (*right*), daughter-cum-son of entertainers Sonny and Cher. After living most of her adult life as a lesbian, Bono announced in mid-2008 that he was in fact a transsexual and had begun to transition from the lesbian “Chastity” to the straight male identity of “Chaz.” (Chaz is just as attracted to his girlfriend, Jennifer, as Chastity was before the transition, only given Bono’s physical metamorphosis, theirs is arguably no longer a same-sex relationship.) As a female-to-male (FtM) transsexual, Chaz has already had his breasts removed and has embarked on a

regimen of testosterone treatment, which has caused his voice to drop by a full octave as well as stimulated a noticeable five o’clock shadow.

“Gender is between your ears and not between your legs,” Bono said during a 2009 interview with ABC’s *Good Morning America*. “As a child, it was really clear. I felt like a boy ... As you get



**Chaz Bono, formerly Chastity, is a female-to-male transsexual. Before his 2008 sex change, Chaz spent years as a lesbian because of pressure to fit in as a woman.**

older, it gets more confusing, because suddenly there’s more pressure to fit into your assigned gender identity. [And so] a lot of FtMs end up doing a stint in the lesbian community because it just kind of makes sense.”

Nearly all FtM transsexuals have a similar story—they are overwhelmingly homosexual (attracted to women). Male-to-female (MtF) transsexuals, on the other hand, are a much more diverse group, in terms of both their sexual orientation and the psychological underpinnings of their transsexuality.

In the late 1980s University of Toronto psychiatrist Ray Blanchard introduced the theory of “autogynephilia,” in which he argued that heterosexual MtF transsexuals (that is, biological males who are attracted to women but who wish to transition to a female identity) are in fact sexually aroused by the thought of themselves as females. As an example of autogynephilia, consider the following account by male-to-female transsexual Nancy Hunt in her memoir *Mirror Image* (Holt, Rinehart and Winston, 1978). “I was feverishly interested in [girls],” Hunt writes. “I studied their hair, their clothes, their figures. And I brooded about the increasing differences between us. I seethed with envy while at the same time becoming sexually aroused—I wanted to possess them even as I wanted to become them. In my night-time fantasies, as I masturbated or floated towards sleep, I combined the two compulsions, dreaming of sex but with myself as the girl.”

### Love Thy Self

According to Blanchard, such cases exemplify “erotic target location errors,” in which individuals seek to change their appearance so that they more resemble the persons or things they desire. Whereas most people search for their erotic targets elsewhere, autogynephiles are prone to a search strategy error whereby they identify the object of their desires under their very own skin.

Unsurprisingly, Blanchard’s theory of autogynephilia rubs many transsexuals the wrong way. Sex may be a part of it, they say, but their identities have less to do with deviant desires than with feeling simply that they are women trapped in the bodies of men. But recently a prominent psychologist named Anne Lawrence—a male-to-female transsexual herself—has advocated a more nuanced version of Blanchard’s theory. Just as relationships evolve from primarily lusty and erotic attractions to more romantic, less overtly sexual forms of love, she says, so, too, might autogynephiles slowly develop a nonsexual, romantic attachment to themselves as women.

Lawrence bases her theory on the sim-

### (The Author)

Experimental psychologist **JESSE BERING** is director of the Institute of Cognition and Culture at the Queen’s University, Belfast. He writes the featured blog “Bering in Mind” for [www.ScientificAmerican.com](http://www.ScientificAmerican.com). Bering’s first book, *The Belief Instinct: The Hidden Psychology of Souls, Destiny and the Meaning of Life*, is forthcoming from W. W. Norton in the fall of 2010.



ilarities she has noticed among the heterosexual MtF transsexuals in her Seattle clinic. Most are quite masculine in appearance and have led successful lives as men, usually in male-dominated professions such as engineering, business or computer science; often they are married and have several children. Curiously, many have autisticlike traits: they seem more interested in “things” than in other people and have a background of poor social relationships. And almost invariably, Lawrence points out, they have a history of sexual arousal by cross-dressing.

In a 2007 article in *Perspectives in Biology and Medicine*, Lawrence writes that the heterosexual MtF transsexuals she has seen “typically want to undergo sex reassignment surgery as quickly as possible and want their new genitals to resemble as closely as possible the female genitals they love and idealize. After surgery, these transsexuals are not only relieved to be rid of their male genitals but are delighted with their female-appearing genitals and are often eager to display them to other people (e.g., at transgender support group meetings).”

In contrast, homosexual MtF transsexuals—those attracted to men—do not idealize female genitalia and “often seem indifferent or ambivalent about undergoing sex reassignment surgery,” Lawrence writes. Indeed, most researchers agree that there are meaningful differences between gay and straight MtF transsexuals—including, intriguingly, the cultures in which they exist.

### Emerging Cultures

Cultural influences are perhaps the least understood aspect of transsexuality—in large part because the effects of culture are so hard to define and study. Still, the evidence suggests that these factors strongly influence whether MtF transsexuals tend to be gay or straight. In Far Eastern countries such as Korea, Malaysia, Singapore and Thailand, fewer than 5 percent of MtF transsexuals may be heterosexual. The rest are homosexual biological males, usually extremely feminine in their behavior and appearance and exclusively attracted to men.

(These are the so-called kathoey or ladyboys of Southeast Asia.) In striking contrast, this ratio of gay to straight is almost perfectly flipped in the West, where 75 percent or more of American and British MtF transsexuals are heterosexual— attracted to women—or bisexual.

Lawrence published a study online in December 2008 in the *Archives of Sexual Behavior* that may help explain this trend. She reports that the more a society is collectivist—that is, the more

alinity—differences involving the elusive causal algorithms of individual experience, personality, biology and culture. Scientists working in this area have made considerable progress, but much remains a mystery. Fortunately, the past decade or so has seen transsexuals increasingly “coming out of the closet” as a sexual minority. There was an especially sharp increase in clinic-referred adolescents with gender identity disorder starting in 2004, which is still rising. This dramatic

## Some male-to-female transsexuals may be aroused by the thought of themselves as women. They want to look like the objects they desire.



it values social norms over individual expression—the greater the percentage of homosexual MtF transsexuals. This correlation, she says, could result from the fact that in collectivist countries, such as those in Southeast Asia, effeminate, homosexual men are not well tolerated—they may fare better as women in accepted transgender roles such as ladyboys. Men who are too masculine to pass as women, on the other hand, would be shunned if they tried to do so. Countries such as the U.S. and the U.K., on the other hand, place more value on individual expression and personal choice and are therefore more tolerant of both effeminate men and masculine MtF transsexuals.

Clearly, there are radical differences underlying the expression of transsexu-

spike may be the result of the destigmatizing influence of media exposure. Movies such as *Boys Don't Cry* (1999) and *Transamerica* (2005) offer sympathetic portrayals of transsexuals, and the subject of childhood gender identity disorder has been featured in the *New York Times*, on ABC's *20/20* and on the *Oprah Winfrey Show*.

As transsexuals continue to become more open about their experiences, scientists are realizing that cross-gender behavior is not only a fascinating expression of human variation but also a richly informative area for studying the subtlest vagaries of sexuality. Like no other aspect of our nature, transsexuality is where biology, gender and sexual orientation meet—and, as we have seen, often part ways. **M**

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# Are Men the More Belligerent Sex?

Men are more dangerous, but women can be just as aggressive

BY SCOTT O. LILIENFELD AND HAL ARKOWITZ

**THE NOTION** that men have shorter fuses than women has acquired the status of a psychological shibboleth. More than 30 years ago Stanford University psychologists Eleanor Maccoby and Carol Jacklin concluded in an influential book that sex differences were minimal in most psychological traits but considerable when it comes to aggression. This opinion has endured ever since.

Were Maccoby and Jacklin right? Recent research bears out the broad brushstrokes of their claim but reveals that women can be equally, if less dangerously, belligerent.

## Mad Men

In 1995 the late psychologist David Lykken of the University of Minnesota wrote that if we could magically place all boys and men between the ages of 12 and 28 in a cryogenic freeze, we would slash the rate of violent crime by two thirds. The data bear out Lykken's thought experiment. In the U.S., the rate of violent crime for girls and women aged 10 and older is one in 56; the corresponding figure among their male counterparts is one in nine. Men commit close to 90 percent of the murders in the U.S. and more murders than women in all the countries researchers have examined, according to a 1999 report by psychologist Anne Campbell of Durham University in England.

Indeed, investigators have consistently found that short of criminal activity, men exhibit more frequent and more extreme levels of physical aggression with one exception: in domestic disputes, as we will see, the tables are often turned. In a 2004 mathematical synthesis of 196 studies (known as a meta-analysis), psychologist John Archer of the University of Central Lancashire in England found that men are more physically aggressive



Just one in 56 girls and women in the U.S. commits a violent crime. The corresponding rate for men: one in nine.

(by various measures) than women across all ages, with the difference peaking between the ages of 20 and 30. This sex difference extended to all 10 countries Archer examined, which included the U.S., Finland, Spain, India, Japan and New Zealand. Interestingly, researchers have found men to be more physically aggressive in their mental lives as well. Compared with women, men harbor more fre-

quent and enduring homicidal fantasies, more often think about enacting revenge against their enemies, and report more physically aggressive dreams.

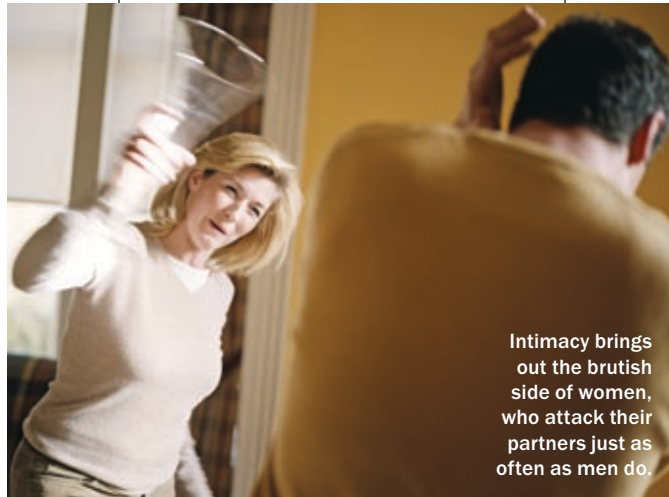
## Evening the Score

Still, studies show that women are at least as prone to feeling anger as men and that they fight plenty. Instead of expressing their angry emotions with their

COURTESY OF SCOTT O. LILIENFELD (Lilienfeld); COURTESY OF HAL ARKOWITZ (Arkowitz); SUPERSTOCK/GETTY IMAGES (punching fist)

**Relational aggression** includes spreading rumors, gossiping, glaring, eye rolling and giving others the “silent treatment.”

fists, women tend to use what in 1995 psychologist Nicki Crick, then at the University of Illinois, termed “relational aggression,” a less overt form characterized by social manipulation, especially of same-sex peers. Popularized by such books as *Odd Girl Out: The Hidden Culture of Aggression in Girls*, by Rachel Simmons (Harcourt, 2002), relational aggression includes spreading rumors, gossiping, glaring, eye rolling, giving others the “silent treatment,”



Intimacy brings out the brutish side of women, who attack their partners just as often as men do.

sending nasty notes or text messages behind rivals’ backs, excluding others from social gatherings, poking fun at the appearance of competitors, and assorted other stealth attacks. The so-called gentler sex may opt for such tactics because they are socialized to not show hostility openly and also because their relative lack of physical strength makes violence seem a less promising strategy.

Girls do not have an exclusive claim to relational aggression, however. A 2008 meta-analysis by psychologist Noel Card of the University of Arizona and his colleagues suggests that it is equally common in girls and boys across both childhood and adolescence. Other research suggests this absence of sex differences persists into adulthood.

More surprisingly, women are also just as likely as men to express hostility—in this case physically—in the context of a romantic relationship. The popular stereotype of a domestic abuser is a man who habitually hurts his female partner. Yet research by Archer and sociologist Murray Straus of the University of New Hampshire calls this scenario into question. Surprisingly, their analyses demonstrate that men and women exhibit roughly equal rates of violence within relationships; some studies hint

that women’s rates of physical aggression are slightly higher. This apparent equality is not solely a result of women fighting back, because it holds even for altercations that women start. Still, domestic abuse within intimate relationships poses a greater threat to women than to men. Women suffer close to two thirds of the injuries, largely because men are stronger on average than women. In addition, women and men differ in the severity of their actions; women are more likely to scratch or slap their partners, and men more commonly punch or choke their partners.

### Biology to Blame?

Until recently, most psychologists thought differences in the degree to which men and women exhibit physical aggression stemmed largely from societal reinforcement of traditional gender roles. Social factors undoubtedly ac-

count for a part of the differences. But in a study published in 2007 psychologist Raymond Baillargeon of the University of Montreal and his colleagues reveal that as early as the age of 17 months, 5 percent of boys but only 1 percent of girls engage in frequent physical aggression, such as kicking and biting. What is more, this gap does not widen between 17 and 29 months, as might be expected if environmental influences such as socialization by parents were to

blame. These findings suggest that biological factors—such as the effects of testosterone on brain function—contribute to sex differences in violent behavior.

Bolstering this hypothesis is the fact that males are the more belligerent sex in virtually all mammalian species that biologists have studied. Even the one marked exception to this trend—the spotted (“laughing”) hyena—may prove the rule. The female hyena, which is more physically aggressive than her male counterpart, has higher testosterone levels than the male does. **M**

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

Send suggestions for column topics to [editors@SciAmMind.com](mailto:editors@SciAmMind.com)

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AGE FOTOSTOCK

# Changing the Dating Game

When women approach men instead of vice versa, the gender difference in selectivity disappears

BY WRAY HERBERT



**WOMEN ARE MUCH CHOOSIER** than men when it comes to romance. This is well known, but the reason for this gender difference is unclear. Evolutionary psychologists think it is because back in prehistoric times “dating” was much riskier for women. Men who made an ill-advised choice in the ancient version of a singles bar simply had one lousy night. Women who chose unwisely could end up facing years of motherhood without the critical help that a stable partner would have provided.

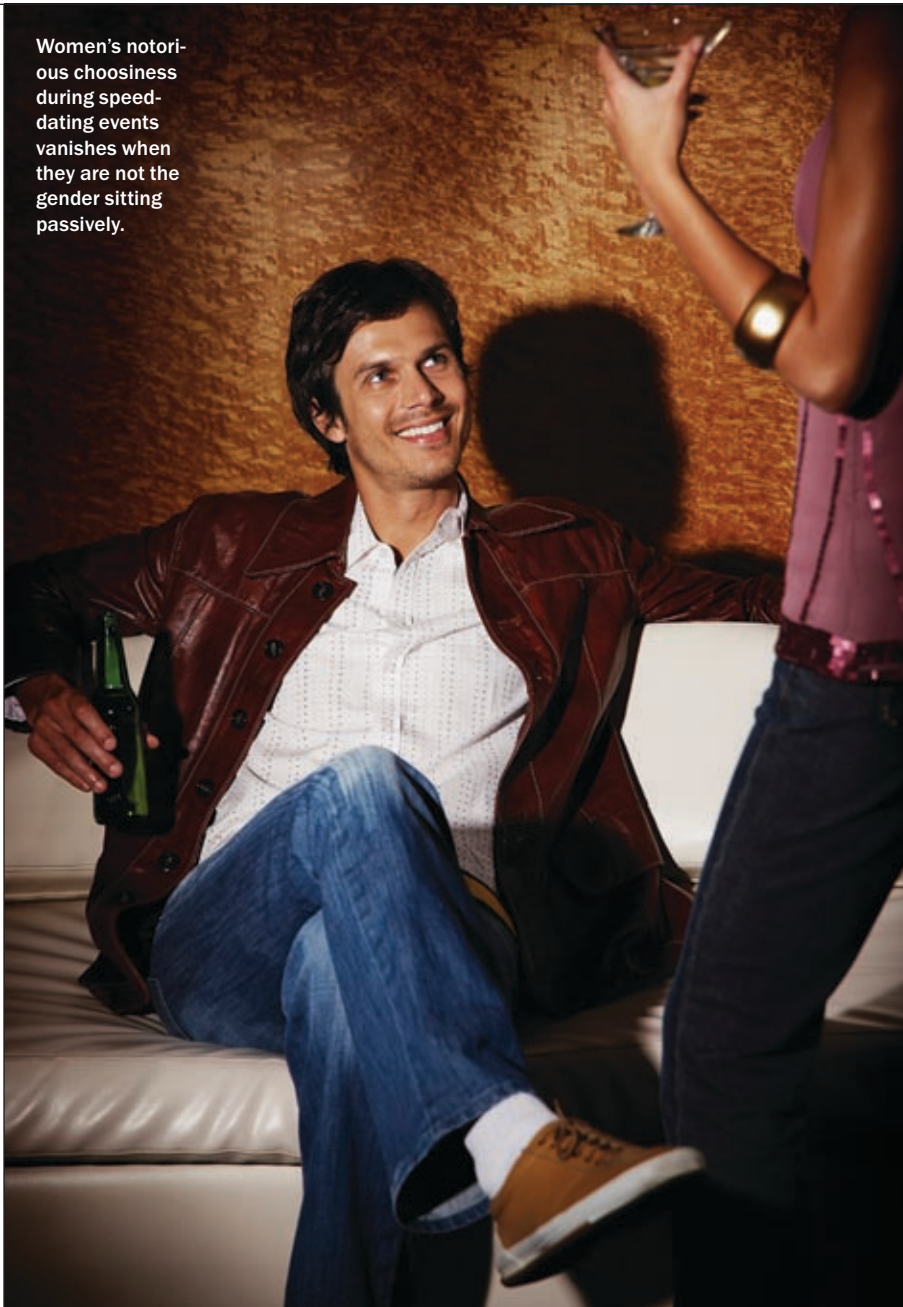
That is less true today, yet women remain much more selective. Is this difference a vestige of our early ancestry? Or might it be totally unrelated to reproductive risk, the result of something more modern and mundane? A couple of Northwestern University psychologists, Eli J. Finkel and Paul W. Eastwick, decided to explore this question in an unusual laboratory: a real-life speed-dating event.

## People in Motion

For the uninitiated, speed dating is an increasingly popular way for men and women to meet and find potential partners. Participants attend a sponsored event and go on a series of very brief “dates,” about four minutes each. Typically the women sit scattered around a room, and the men make the rounds. Afterward, both men and women indicate to the sponsor if they would be interested in seeing any of the others again. If two “yeses” match up, they get phone numbers and that’s it. They’re on their own.

Men say “yes” a lot more than women. That is expected, but Finkel and Eastwick had a novel theory about why. Perhaps it could be explained by the simple convention of men standing and approaching—and women sitting passively. There has been a lot of recent work on the mutual influence of body and mind—

Women’s notorious choosiness during speed-dating events vanishes when they are not the gender sitting passively.



how we embody our thoughts and emotions. For example, body movements can subconsciously influence people’s attitudes toward another race. In a 2007 study at York University in Canada psychologists found that nonblack partici-

pants who were trained to pull a joystick toward them when they saw a picture of a black person subsequently had fewer implicit (subconscious) biases against blacks than people who were trained to push the joystick away or to the left or

MATT MENDELSON (Herbert); CORBIS (couple)

# Standing and being on the move boosted both genders' confidence, which in turn boosted romantic attraction.

right. Pulling the joystick was similar, in a psychological sense, to approaching the individuals in the pictures—and when people approach someone, their feelings about that person tend to warm.

Finkel and Eastwick speculated that in speed dating, physically approaching someone might be enough to make the potential date more appealing romantically—and thus, because men usually approach women in such events, to make the men less choosy overall.

They tested this hypothesis in a series of 15 heterosexual speed-dating events, involving 350 young men and women. Each participant went on about 12 dates, but the researchers changed the rules: in seven of the events, the women approached the men, so overall both genders approached each other about equally. After each date, the participants rated their partners for romantic desirability and romantic chemistry. They also rated their own sense of self-confidence on the date. After all the brief dates were over, they decided thumbs up or thumbs down for each candidate.

## Hello, I Love You

The results were a score. As reported in the October 2009 issue of *Psychological Science*, the well-known gender difference vanished when men and women assumed more egalitarian roles—when women made the rounds and men sat, both sexes were equally choosy. This finding is not a complete reversal of the old rule, however; the seated men were not choosier than the traveling women, the way seated women are choosier than men in the traditional speed-dating set-



Approaching someone increases your feelings of warmth for that person.

more selective when they were seated. The investigators had wondered whether the act of sitting and being approached by a long string of members of the opposite sex made people feel especially desirable and, therefore, justifiably choosier. But they found that those who rotated showed more self-confidence than those who sat, nixing the idea that the sitters' perception of being in great demand was driving their relative choosiness. Instead simply standing and being on the move boosted both genders' sense of confidence, which in turn boosted their romantic attraction to the people they approached.

We don't speed-date our way through real life, of course, but there are all kinds of social conventions based on gender, and these presumably shape romantic feelings and actions. Having men behave more like

women and women more like men appears to narrow at least this one gap between the sexes. **M**

up. This suggests that the ancient tendencies still exist but may be less influential than previously thought, because they are also reinforced by arbitrary social norms such as the convention that men usually approach women when there is potential for romance.

What's more, by asking the participants to rate their self-confidence, the researchers provided further insight into what specifically about the speed-dating setup led both men and women to be

➤ For more insights into the quirks of human nature, visit the "We're Only Human..." blog and podcasts at [www.psychologicalscience.org/onlyhuman](http://www.psychologicalscience.org/onlyhuman)

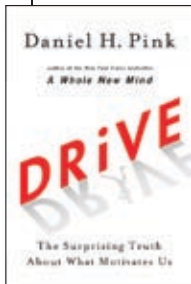
WRAY HERBERT is senior director for science communication at the Association for Psychological Science.

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books

FINDING INSPIRATION



Drive: The Surprising Truth About What Motivates Us

by Daniel H. Pink. Riverhead Books, 2009 (\$26.95)

What pushes employees to do their best work? Many businesses operate under the belief that the key to motivating

workers is giving them tangible rewards, such as a cash bonus or a corner office. In the book Drive, business writer Daniel H. Pink argues persuasively that these companies have it all wrong. He cites a body of behavioral science research that suggests that optimal performance comes when people find intrinsic meaning in their work.

Pink points to studies that show creating incentives can be counterproductive. This idea was first hinted at in the 1960s, when psychologist Sam Glucksberg, now at Princeton University, experimented with the "candle problem," a test in which participants are given a candle, matches and a box of tacks and asked to fix the candle to a wall (the solution lies in using the box as a platform). Volunteers who were offered cash

to solve the problem fast actually took longer to finish because, as Glucksberg concluded, focusing on the reward interfered with the volunteers' ability to concentrate on completing the task at hand. In a more recent study, researchers at Harvard Business School asked a panel of artists and curators to rate pieces of artwork for creativity and technical skill without knowing whether or not the works were commissioned. The panel ended up ranking commissioned pieces lower in creativity than noncommissioned pieces, even though they found no difference in technical skill.

Although incentives seem to hamper performance, Pink acknowledges that not all are bad. Dangling carrots may be useful in getting people to plow through boring, routine work. But in the fast-changing 21st-century economy, the success of individuals and organizations increasingly depends on being nimble and innovative, so there is more and more need for people to find intrinsic value in their work. Pink identifies three elements underlying such intrinsic motivation: autonomy, the ability to choose what and how tasks are completed; mastery, the process of becoming adept at an activity; and purpose, the desire to improve the world.

Drive highlights businesses that promote these values. Google lets its engineers work on any project they choose for

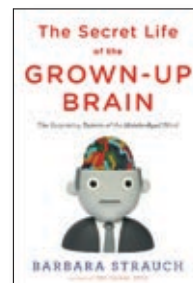
20 percent of their time—a policy that has yielded popular products, including Google News. Toms Shoes in California matches every sale with a charitable donation of a pair of shoes to a child in the developing world. Pink also cites educational institutions such as Montessori schools that let kids follow their natural curiosity in self-directed activities. Moving beyond the world of work, he advocates designing your own exercise program rather than following a gym's cookie-cutter one to motivate you to break a sweat.

A limitation of Drive's argument is that many people may be too busy making ends meet to seek out work or other activities that hold intrinsic interest. Still, Pink makes a convincing case that organizations ignore intrinsic motivation at their peril. —Kenneth Silber

LATE BLOOM

The Secret Life of the Grown-up Brain: The Surprising Talents of the Middle-Aged Mind

by Barbara Strauch. Viking, 2010 (\$26.95)



Brains, like certain French cheeses, get better with age. That's the message of The Secret Life of

television

ANIMAL BONDING

The Horse Boy

PBS, May 11 at 10 P.M. EST pbs.org/horse-boy

After countless modern medical treatments failed to help their autistic son speak, Rupert Isaacson and his wife, Kristin Neff, looked for hope in the untested. The Isaacson family's adventure, depicted in the PBS documentary The Horse Boy, began when two-year-old Rowan suddenly changed. He stopped speaking words he'd earlier known, retreated into himself and erupted into frequent tantrums. One day, to his parents' dismay, he slipped through a fence and ran into their neighbor's horse pasture. They feared Rowan would get kicked by a spooked horse, but instead he made his first friend: an old mare named Betsy, who gently bent her head down to meet Rowan's.

As Rowan spent time with Betsy, he grew calmer and his speech improved. Rowan's father, a former horse trainer, realized he had finally found a way into his son's world. With a little research, he discovered that shamans in Mongolia use horses as part of their traditional healing methods. The Isaacsons soon packed their bags and left their home in Austin, Tex., with Rowan, now five years old, on an uncertain and hopeful quest.



The documentary, based on a book by Isaacson, follows the family's struggles and joys as they search for a miracle. The audience, along with Rowan's parents, wonders if the trip is in the boy's best interests when his shrill screams accompany a chaotic shaman ceremony. Yet the magic of the journey is apparent when, in nearby Siberia, Rowan brushes his fingertips along a reindeer's furry antlers, smiles and says, "Reindeer. Cute." —Corey Binns

*the Grown-up Brain*, which takes a detailed look at an avalanche of new research showing that human brains hit their prime when their owners are between their early 40s and late 60s—much later than previously thought.

In accessible and entertaining prose, journalist Barbara Strauch explains how and why our brain's performance—as opposed to that of the rest of our body—actually improves as we move through middle age. Sure, we may get a little more forgetful, say when it comes to remembering names or where we left our keys, but the middle-aged brain is unsurpassed in handling the important stuff, Strauch says. A recent study of 118 pilots aged 40 to 69 showed, for example, that the older participants outperformed their younger colleagues when avoiding traffic collisions using simulators. One reason Strauch gives is that we begin to use a larger portion of our brain as we age.

For example, studies in which volunteers learned pairs of words revealed that younger adults used only their right frontal lobes when recalling the twosome while older adults used both the left and right side. This is “much like using two arms instead of one to pick up a heavy chair,” Strauch says. The study's results fly in the face of the long-held view that as time goes on people use a smaller portion of their brain. But that's not all. Researchers have also found that the amount of myelin, the fatty substance that insulates nerve fibers, continues to increase well into middle age, boosting brain cells' processing capacity.

Strauch's book paints a radically new picture of the brain that goes far beyond making those entering middle age feel better. Instead the newly gained insights into the adult brain should cause us to rethink how we structure our lives, Strauch says. Right now we “tell people to get out of the way at sixty-two—too old to teach, too old to be a doctor, too old to be a lawyer,” even though that's when the brain's performance reaches its peak. So, rather than treating the middle-aged brain as “diminished, declining, and depressed,” we should embrace it for what it actually is: “ripe, ready, and whole.”

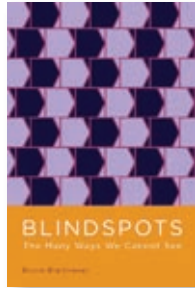
—Nicole Branam

► **FAULTY SIGHT**

**Blindspots: The Many Ways We Cannot See**

by Bruno Breitmeyer. Oxford University Press, 2010 (\$39.95)

Do you think what you see is always what you're looking at? Then think again, says



neuroscientist Bruno Breitmeyer. In his book *Blindspots*, Breitmeyer shows us that there can be large differences between the information that enters our eyes and the pictures that our mind constructs from it.

*Blindspots* surveys findings from various research fields that deal with vision and visual perception. Interspersed with these facts are fascinating experiments and tricks that illustrate the phenomena described—and that readers can try themselves. The book's essay style, however, makes it overall a rather dry read.

Breitmeyer spends a good deal of the book discussing in depth the biological underpinnings of how our eyes work and what happens in various diseases and injuries that impair eyesight. Readers learn, for example, that severing specific nerve fibers once left a patient unable to recognize written words. This person's brain could still take in the shapes of letters but could no longer communicate the information to the brain regions responsible for word recognition, making the patient “word-blind.”

It's not just illness or injury, however, that can harm our visual perception; experience plays an important part as well, Breitmeyer explains. Studies have shown, for example, that if chimpanzees are not allowed to actively explore their environment when growing up they have a hard time discriminating between similar geometric shapes, such as a triangle oriented upright and one that is upside down. The same will likely happen to neglected infants, Breitmeyer argues, making it difficult for them to distinguish between similar-looking letters, such as t and f.

Our cultural inheritance shapes the way we see, too, Breitmeyer explains. For example, research has shown that those who live in a city or town are particularly well attuned to horizontally and vertically oriented lines because that is mainly what they see in the form of buildings, streets, and so on. That is not the case for those who spend most of their time in an environment dominated by oblique shapes, such as tepee dwellings. And, as everyone knows, strong emotions can make us nearly blind to certain facts. Breitmeyer concludes that “to see in the fullest sense of the word, it is not enough to open your eyes; you also must come with an open mind.”

—Nicole Branam

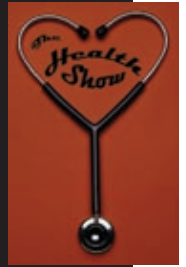
radio

► **BEHIND THE SCENES**

**The Health Show**

<http://healthshow.org>

Ever wonder what it's like to raise two autistic children? Do dementia medications really make a difference? How does music help people with traumatic brain injuries?



These are questions recently posed by *The Health Show*, a nationally syndicated radio program broadcast on 160 U.S. radio stations and available online for free. Co-hosted by veteran radio personality Bob Barrett and gastroenterologist Nina Sax, the broadcast covers a range of topics, frequently exploring mental health and neuroscience issues such as autism, addiction and the aging brain.

The show doesn't simply provide overviews of various topics; it explores what happens behind the scenes for both doctors and patients. The hosts aren't afraid to ask probing questions and challenge the status quo. In a recent sequence, for instance, psychologist Ira Rosofsky questioned the common practice of treating elderly patients with expensive antedementia drugs such as Aricept and Namenda. He argued that although the drugs make little difference in patients' lives—improving cognitive test scores by only 4 percent—doctors choose to medicate them anyway because it's easy. “Why not admit the failure of medication and, instead, spend some of those billions of dollars on more staff to hold the hands of both patients and their families?” he asked.

In addition to its excellent reporting, *The Health Show* shines because it frequently deviates from the popular talk show question-and-answer format in favor of having guests share their personal stories in touching vignettes. Listeners feel like they are part of the experience as they gain not only a nuanced understanding of complex health problems but also a profound respect for the people who are fighting them.

—Melinda Wenner

# asktheBrains

**Can an old head injury suddenly cause detrimental effects much later in life?**

—Anonymous, via e-mail



**Douglas Smith**, professor of neurosurgery and director of the Center for Brain Injury and Repair at the University of Pennsylvania, answers:

**ALTHOUGH A BRAIN INJURY** from a car accident or a collision during a football game often seems to cause a sudden change to cognitive ability years later, this change does not just appear out of the blue—the damage has been building up slowly, unnoticed, over time.

Postinjury, the progressive brain deterioration that may occur likely reaches a tipping point, after which the loss of function “suddenly” becomes obvious. Depending on the type and severity of the traumatic brain injury (TBI), it can accelerate memory loss or increase a person’s chance of succumbing to Alzheimer’s disease.

TBI commonly damages nerve fibers in the brain called axons. These thin, tubelike structures transmit electrical and chemical signals that are vital for carrying information among different regions of the brain. For unknown reasons, these fragile structures not only disconnect shortly after injury but can continue to disconnect even for decades later in some patients. Once disconnected, the blunt end of an axon seals itself off, swells with fluids, enzymes and proteins and eventually bursts. When axons burst open, they often distribute amyloid proteins through the neighboring brain tissue. These sticky proteins are a hallmark of Alzheimer’s, and in fact many TBI patients exhibit signs of dementia later in life that mimic the deterioration observed in Alzheimer’s patients.

In addition, with axons disappearing or not functioning well after TBI, a

person’s ability to process new information may slow down. Surviving axons may compensate for the damage by increasing electrical signaling and thus restoring the normal speed of information processing in the brain. This temporary fix, however, can cause these axons to become even more sensitive to damage if a second concussion occurs.

Most people with TBI will have progressive axonal damage, but it is difficult to predict who will suffer from cognitive changes years later. TBIs have a devastating effect on society, with more than 1.5 million cases documented in the U.S. every year. Currently no therapies exist for either short- or long-term damage, which means for now the best treatment is protection and prevention.

**What is the memory capacity of the human brain? Is there a physical limit to the amount of information it can store?**

—J. Hawes, Huntington Beach, Calif.



**Paul Reber**, professor of psychology at Northwestern University, replies:

“**MR. OSBORNE**, may I be excused? My brain is full,”

a student with a particularly tiny head asks his classroom teacher in a classic *Far Side* comic by Gary Larson. The deadpan answer to this question would be, “No, your brain is almost certainly not full.” Although there must be a physical limit to how many memories we can store, it is extremely large. We don’t have to worry about running out of space in our lifetime.

The human brain consists of about one billion neurons. Each neuron forms about 1,000 connections to other neurons, amounting to more than a trillion connections. If each neuron could only help store a single memory, running out of

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space would be a problem. You might have only a few gigabytes of storage space, similar to the space in an iPod or a USB flash drive. Yet neurons combine so that each one helps with many memories at a time, exponentially increasing the brain’s memory storage capacity to something closer to around 2.5 petabytes (or a million gigabytes). For comparison, if your brain worked like a digital video recorder in a television, 2.5 petabytes would be enough to hold three million hours of TV shows. You would have to leave the TV running continuously for more than 300 years to use up all that storage.

The brain’s exact storage capacity for memories is difficult to calculate. First, we do not know how to measure the size of a memory. Second, certain memories involve more details and thus take up more space; other memories are forgotten and thus free up space. Additionally, some information is just not worth remembering in the first place.

This is good news because our brain can keep up as we seek new experiences over our lifetime. If the human life span were significantly extended, could we fill our brains? I’m not sure. Ask me again in 100 years. **M**

Have a question? Send it to [editors@SciAmMind.com](mailto:editors@SciAmMind.com)



# Head Games

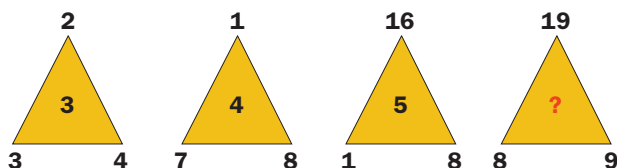
Match wits with the Mensa puzzlers

## 1 WEIGHING IN

Mary's husband loved fishing, and Mary always asked when he returned home how big a fish he had caught. One day when she asked, he whimsically answered: "It weighs three fourths of its weight plus one half of half a pound." What did the fish weigh?

## 2 TRIANGLE TRICK

The following number triangles are arranged based on a certain rule. Decipher the pattern and fill in the missing number in the last triangle.



## 3 IT'S ALL IN THE TIMING

Bobby was attempting to reassure his girlfriend after they stayed out very late. "It's all right," he said. "If it were seven hours later, we'd only have to wait one fifth as long until noontime as we would have to wait if we had come home an hour earlier. So it isn't really all that late." How late was it?

## 4 MEET YOUR MATCH

These matchsticks spell out an equation that is wrong. Rearrange the matchsticks to make zero or its equivalent.



## 5 MAY-DECEMBER

"It's remarkable how time flies," John said to his wife, Joan. "When we were married, 25 years ago, I was exactly twice as old as you were." He looked at her in astonishment and continued, "But now I am only older by half your age." How old are John and Joan now, and how old were they when they were married?

## 6 DROP-IN QUOTE

Unscramble this quotation and its author by filling in each square with one of the letters in the column below it.



A	A	F	E	E	D	A	A	E	D	N	H	I	N
M	O	N	O	O	L		A	N	O	S	O	O	S
P		R	T	Y			R	N					

## 7 CREATIVE CORRESPONDENCE

Poor Samantha. If she didn't answer by return mail, Tom would think she didn't want to marry him. Unfortunately, she had lost her address book and had no way of getting in touch. Then she thought for a minute. She knew the name of Tom's street and remembered that the house number was four digits, starting with a 5 and ending with a 6. And her brother, Jack, had commented that the number was the square of its last two digits. That was enough—she had the number! Do you?

## 8 HOMONYM POEM

A lonely young lady sat on the beach and composed an impromptu poem about her romantic yearning. Can you figure out the homonym "rhymes" that complete each couplet? (Hint: A homonym is a word that sounds like another word but has a different meaning, such as "ate" or "eight.")


- Alone on a lovely tropic \_\_\_\_\_
- I dream of going down the \_\_\_\_\_
- Thinking of this, I almost \_\_\_\_\_
- Fat or skinny, blond or \_\_\_\_\_
- I'd like my Cupid with his \_\_\_\_\_
- To find for me a likely \_\_\_\_\_
- I sit on the shore and watch the \_\_\_\_\_
- When in wedlock I'd rather be \_\_\_\_\_
- My heart right now is very \_\_\_\_\_
- When he appears, I'm sure 'twill \_\_\_\_\_

## Answers

- 1. One pound.
- 2. 6. (The numbers at the corners add up to a perfect square, and the number in the middle is the square root.)
- 3. 3 A.M.
- 4. 1111
- 5. They are now 50 and 75. They were 25 and 50 when they were married 25 years ago.
- 6. A fool and his money are soon parted. Anon.
- 7. 5776.
- 8. isle; aisle; bawled; bald; bow; beau; tide; tied; sore; soar.


Dwayne Godwin & Jorge Cham

# COUNTING HEADS



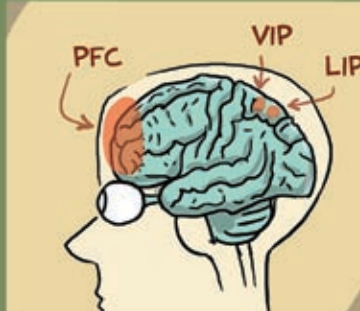
How does **1**'s brain count numbers?

Our ability to judge quantities starts with our **2** eyes and the stream of connections that process visual information.




Where?  
What?

There are **3** regions of particular importance: the prefrontal cortex (PFC) and the ventral (VIP) and lateral (LIP) intraparietal cortices.




PFC  
VIP  
LIP

Studies have found that our capacity to count is usually in place by age **4** and improves with age and education.



um, i'll take that one.

But humans are not the only ones that count. Animals as diverse as fish, ants, bees, elephants and dolphins have this **QUINTESSENTIAL** ability for estimating numbers.




read 'em and weep, boys: five aces!

This **6**th sense, called "numeracy," has obvious evolutionary advantages.




there're only two of them. we can take them!

In a **2007** experiment, neurobiologists discovered neurons in the LIP that fire their synapses in proportion to the number of objects that need counting. Other experiments have found that certain neurons only activate for specific numbers, like "**7**."




??

In Japan, a recent study found that chimpanzees can outperform humans in remembering numbers flashed briefly in front of them. One monkey, named Ayumu, can remember up to **8** numbers with **80%** accuracy.



??  
4-7-3-2...

Of course, basic counting is only the beginning of our complex ability to process abstract numbers and carry out advanced math. Can a German shepherd do Calculus?



Nein (9).

$$\frac{d}{dx}(x^2) = 2x$$
$$f(a)$$
$$\int f(x)$$

● 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](http://www.phdcomics.com)



It's not the advice you'd expect. Learning a new language seems formidable, as we recall from years of combat with grammar and translations in school. Yet infants begin at birth. They communicate at eighteen months and speak

the language fluently before they go to school. And they never battle translations or grammar explanations along the way. Born into a veritable language jamboree, children figure out language purely from the sounds, objects and interactions around them. Their senses fire up neural circuits that send the stimuli to different language areas in the brain. Meanings fuse to words. Words string into structures. And language erupts.

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First, and most importantly, a child's natural language-learning ability emerges only in a speech-soaked, immersion environment free of translations and explanations of grammar. Second, a child's language learning is dramatically accelerated by constant feedback from family and friends. Positive correction and persistent reinforcement nurture the child's language and language skills into full communicative expression. Third, children learn through play, whether it's the arm-waving balancing act that announces their first step or the spluttering preamble to their first words. All the conversational chatter skittering through young children's play with parents and playmates — "...what's this..." "...clap, clap your hands..." "...my ball..." — helps children develop language skills that connect them to the world.

**Adults possess this same powerful language-learning ability that orchestrated our language success as children.** Sadly, our clashes with vocabulary drills and grammar explanations force us to conclude it's hopeless. We simply don't have "the language-learning gene." At Rosetta Stone, we know otherwise. You can recover your native language-learning ability as an adult by prompting your brain to learn language the way it's wired to learn language: by complete immersion. Our award-winning, computer-based method does just that. Dynamic Immersion® unlocks the innate

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**ACT LIKE A BABY.**

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